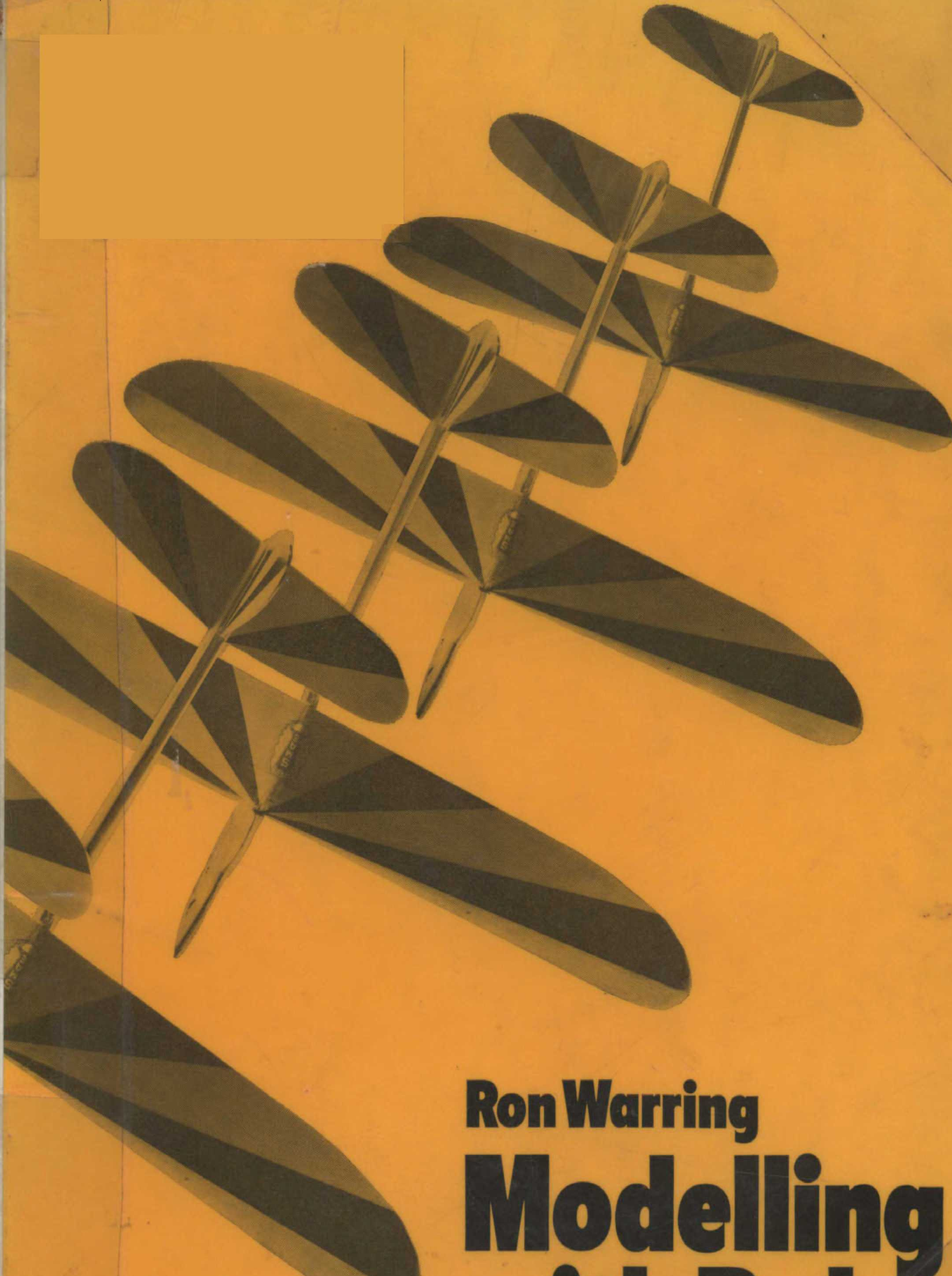
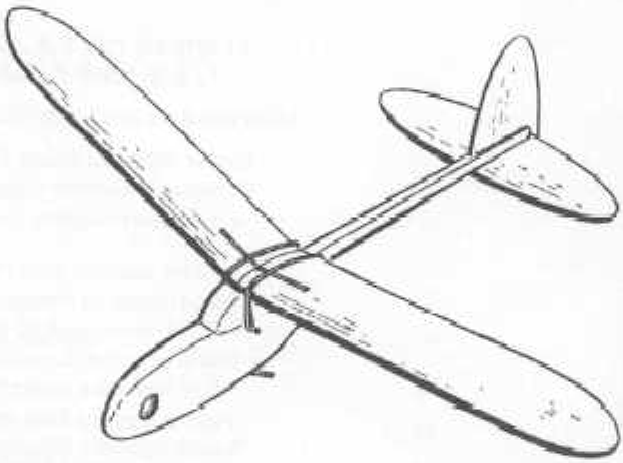
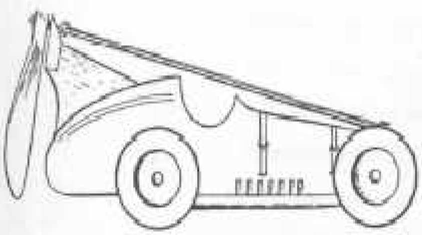


Ron Warring

Modelling with Balsa

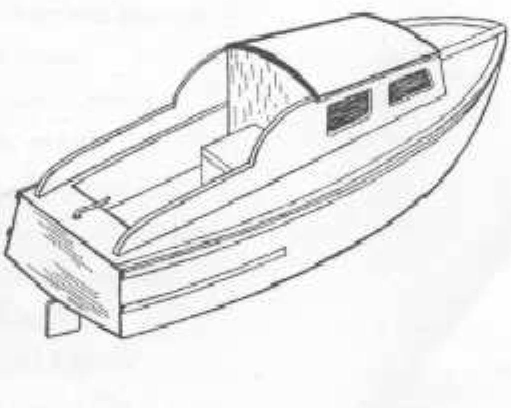
Modelling with Balsa





Modelling with Balsa

RON WARRING



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Balsa as a Modelling Material

Balsa is a natural wood—the lightest of all timbers with the unique property of being very easy to cut and shape and also possessing very good strength for its weight. The balsa-tree is found only in the tropical regions of South America. It is a tree which grows very rapidly (which is one of the principal reasons for its light weight) and is also subject to considerable variations in growth. For this reason balsa wood is not as consistent as an ordinary wood and its actual density may vary between a figure as low as 4 lb. weight per cubic foot to as high as 16 lb. per cubic foot. Its strength, broadly speaking, is directly related to its density, so heavy balsa is stronger than light balsa

Balsa is imported in the form of lumber, which, before being cut to size for the model market, is graded and selected to best suit the modellers' needs. The three broad classifications are: light or soft grade, particularly suitable for model aircraft construction where weight has to be kept to a minimum; 'medium' or the general purpose grade with a density of between 8 and 10 lb. per cubic foot; and 'heavy' grade (12 lb. per cube, and over) for strong parts. For general modelling in balsa, grade is not all that important, except that wood harder than medium grade is more difficult to cut and shape. Where weight, or strength, is a vital factor with a balsa model the grade of the wood is expressed on the plan and the local retailer who supplies balsa sheet, strip and block can always assist in the selection of any particular grade called for.

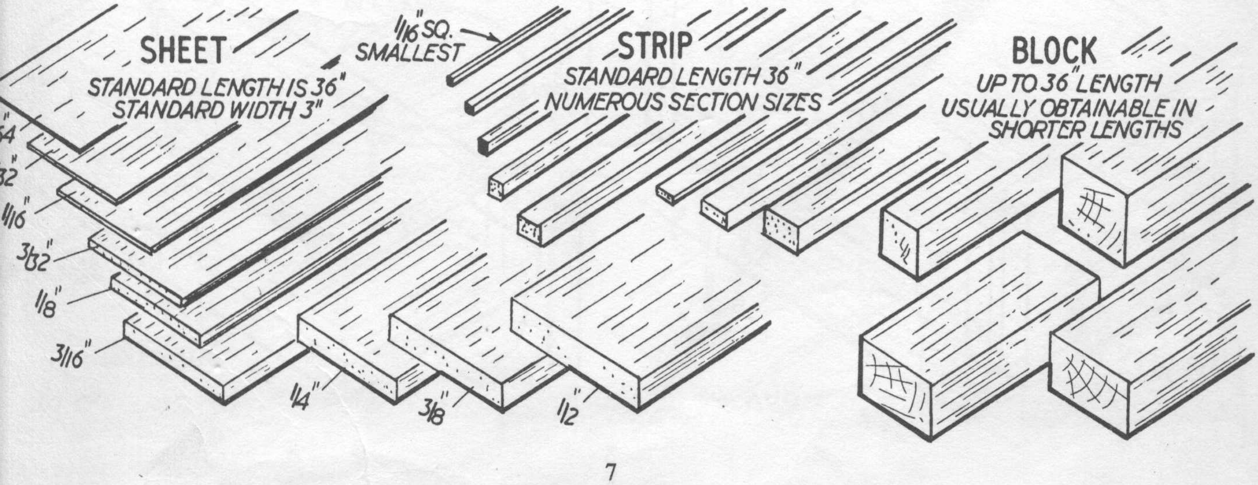
Being so easy to cut and shape is one great attraction with balsa—but there is another. Balsa parts can be jointed strongly with quick-drying balsa cement—producing a glue joint which can be as strong as the wood itself, but setting in a matter of an hour or less. And there is no difficulty about holding parts together whilst setting, for they can be 'clamped' with pins pushed right through the wood with no danger of splitting as with normal woods.

Modelling in balsa, in fact, has been termed 'razor-blade carpentry', which is quite a true statement. Balsa can be cut to shape for a whole variety of models with no other tool than a razor blade, although it is more usual these days to use one of the special modelling knives available with interchangeable blades. The main point is that cutting and shaping balsa is *easy*. Joining and assembling balsa parts is equally easy. And the scope of balsa modelling extends far beyond aero-modelling for which it is, of course, the standard constructional material.

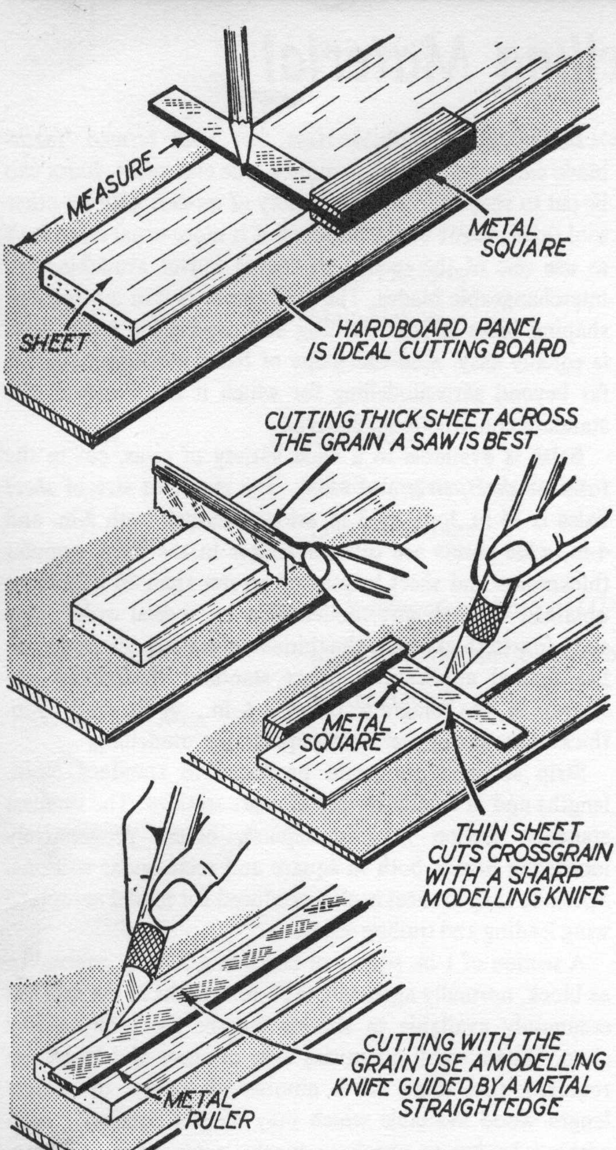
Balsa is available in a wide variety of sizes, cut in the form of *sheet*, *strip* and *block*. The standard size of *sheet* balsa is 36 in. long by 3 in. wide, although both 2-in. and 4-in. wide sheets are often available in the more popular thicknesses and sheet lengths of greater than 36 in. can be obtained through any model shop by special order. One sixty-fourth thickness is the thinnest sheet cut, although this has limited application. Other standard thicknesses are shown in the diagram below—$\frac{1}{16}$-in., $\frac{3}{32}$-in. and $\frac{1}{8}$-in. thicknesses being the most popular for modelling.

Strip sections are again produced in standard 36-in. lengths and in a wide variety of cross sections. The smallest standard section is $\frac{1}{16}$-in. square, others progressively increasing in size both in square and rectangular sections. Specially shaped sheet is also produced for model aeroplane wing leading and trailing edges.

A section of 1-in. square or larger is generally referred to as block, normally again cut as 36-in. lengths at the mill but commonly available in shorter lengths from any model shop. Where small quantities only of sheet and block are required, too, there are a number of 'packs' of shorter length wood available which may meet a particular need without having to purchase surplus material in the form of standard lengths. Again your local model shop proprietor will be able to give you help and advice on this subject.



Cutting Sheet Balsa



Two tools are more or less indispensable for cutting sheet balsa—a really sharp knife and a small fine-tooth saw. A pocket knife is no good for the job. A razor blade is ideal as a cutting tool but more dangerous to use than a proper modelling knife which has interchangeable blades. The same knife handle will also take special razor-saw blades specifically designed for modelling use, although a simple 'Junior' hacksaw (or even a hacksaw blade) will do.

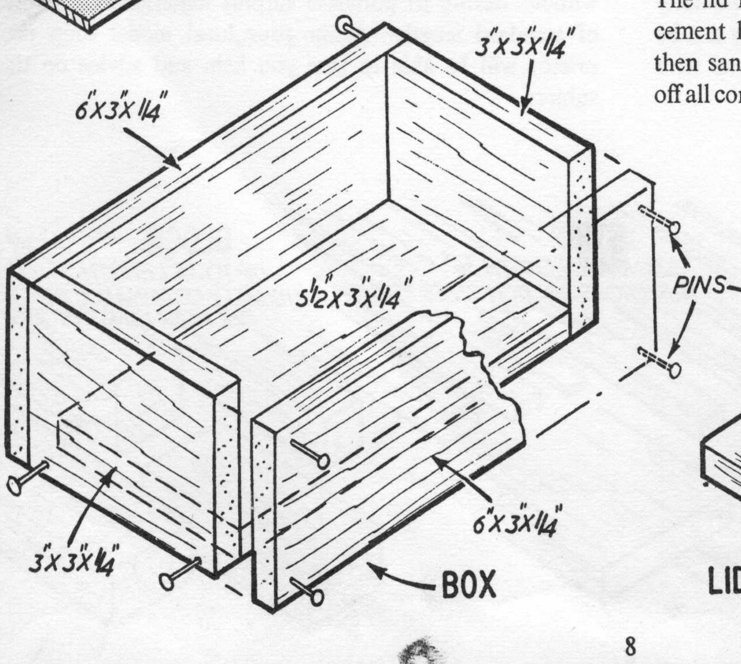
Another indispensable item is a working board on which to do your cutting and model building. A hardboard off-cut panel is about ideal for this. A size of about 18 × 12 in. should be adequate for the range of models described in this book. Other useful items for marking out and cutting are a metal square and metal rule.

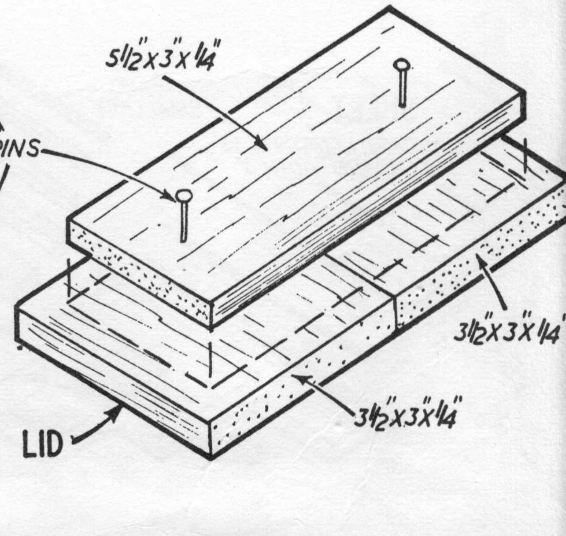
Cutting *thick* sheet *across* the grain is best done with a saw. Any sheet less than $\frac{1}{8}$ in. in thickness can usually be cut cross grain with a knife more readily. Cuts *with* the grain in any thickness sheet are best done with a knife.

When using a knife to make straight cuts, always use a metal rule or metal straight-edge to guide the blade. Never rely on 'freehand' cutting for straight lines.

Now to practise cutting, here is a simple box you can make from a 36-in. sheet of 3 × $\frac{1}{4}$-in. balsa. Mark off and cut two 6-in. lengths for the sides (cross-grain cut, so use a saw). Now cut two 3-in. lengths for the ends (cross-grain cuts again). Now two $3\frac{1}{2}$-in. lengths for the lid pieces. That should leave a 11-in. length which is cut into two $5\frac{1}{2}$-in. pieces. These form the base and the plug-in part of the lid, respectively.

Assembly of the box is clear from the drawing below, cementing all joints well and using pins to hold until set. The lid is assembled separately and left to dry. When the cement has completely set, plug the lid into the box and then sand down all over the outside of the box, rounding off all corners and edges.





More Tips on Cutting

A rather tricky shape to cut out is a perfect circle from sheet balsa—which you might require for a wheel, for instance. The secret lies in working to a true circular shape in *stages* rather than try to cut round the outline in one go. First cut out a square around the marked-out circle. Then cut off the corners to turn into an eight-sided shape. Trim off each corner again in a similar manner—and yet again. You should be pretty near uniform circular shape now and the final finishing to a smooth curve can be done by sandpapering.

Sandpaper, in fact, is as useful as a cutting tool for shaping and finishing balsa. The proper way to use sandpaper is wrapped around a suitable sanding block—and a 5-in. length of ¼-in. sheet makes an excellent 'block'. Cut a piece of sandpaper 4 by 8 in. and wrap right round the block, securing with drawing pins as shown.

Sandpaper is also very useful for enlarging a hole to a bigger size than you can get by drilling. Once the hole has been started—either with a drill or piercing the balsa sheet with a pointed instrument—it can be enlarged with a cone of sandpaper wrapped around a pencil—see sketch. Rotate the sandpaper and pencil one way and the other and it will rapidly work its way through the balsa.

The quickest and neatest way of all of cutting clean holes in balsa is with a sharp metal punch. A short length of metal tubing of the right diameter makes an excellent punch, simply by filing one end to a sharp cutting edge all round. The punch is used by pressing and rotating through the sheet. Do not try to force it straight through as this will almost certainly tear the wood.

A list of tools and equipment needed for balsa modelling follows. Those marked as 'essential' are a minimum requirement for accurate, easy working. The other items can be added one by one to build up your workshop equipment gradually.

Tools and Materials

Cutting Tools:

*_Modelling knife_ with interchangeable blades for general cutting and carving. A short, triangular blade for cutting sheet and strip. A long, parallel blade for carving.

*_Saw_—razor saw for fitting modelling knife handle, as above, or 'Junior' hacksaw. Very useful for cutting thicker sheet across the grain, and block.

Razor blade—useful for fine cutting, cutting thinner sheet 'freehand', and for trimming tissue and paper covering.

Garnafiles—specially shaped wooden forms (like files in appearance) coated with abrasive. Extremely useful for shaping and curving and for 'flatting' cut marks produced by knife carving.

Building Board:

Hardboard sheet—for use as a cutting board. Any convenient size.

Marking-out Tools:

*_Metal ruler_ for measuring and use as a straight edge for cutting.

*_Metal square_—for marking out and checking assemblies for squareness.

Miscellaneous Tools:

*_Pliers_—ordinary pointed-nose type for bending wire parts and cutting wire to length, etc.

Hand drill and drills—for all hole drilling.

Shoemaker's awl—for piercing, pricking, starting holes, etc.

Modelling clamps—useful for holding assemblies where pins cannot be used. (Spring clothes pegs make useful, inexpensive clamps; also 'Bulldog' spring paper clips.)

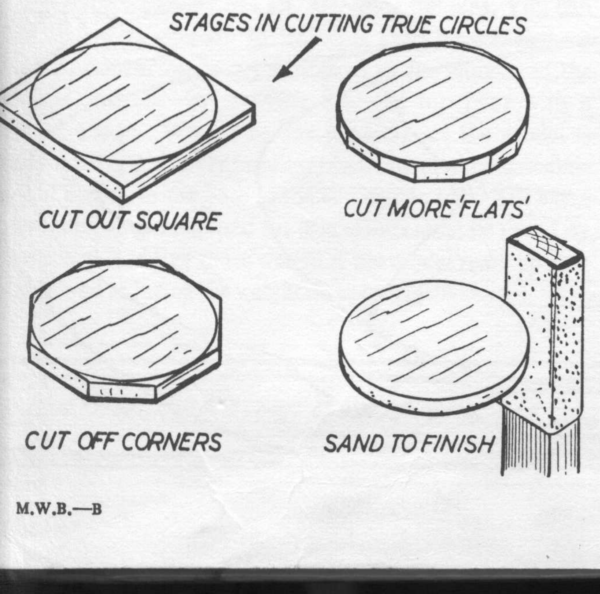
Warding files—flat, triangular, half round, Useful for cutting slots, cutting thicker wire, etc.

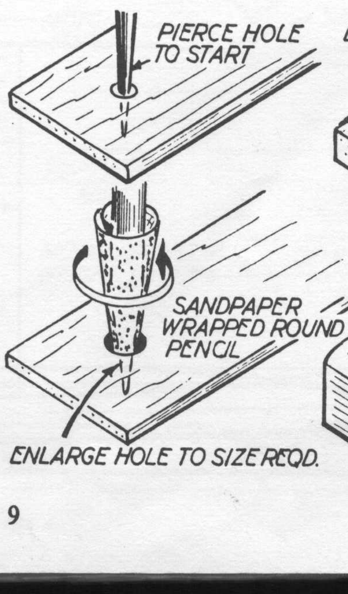
Adhesives:

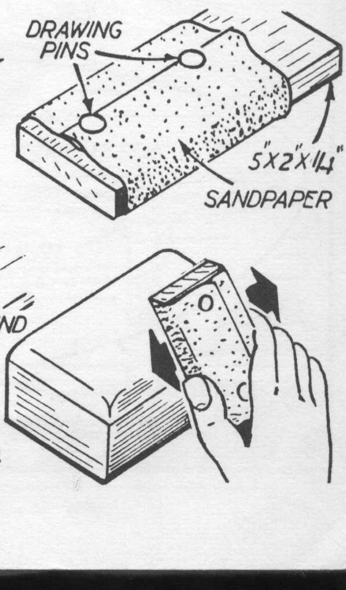
*_Balsa cement_—for all glued joints in balsa.

Tissue cement—for sticking paper or tissue to balsa.

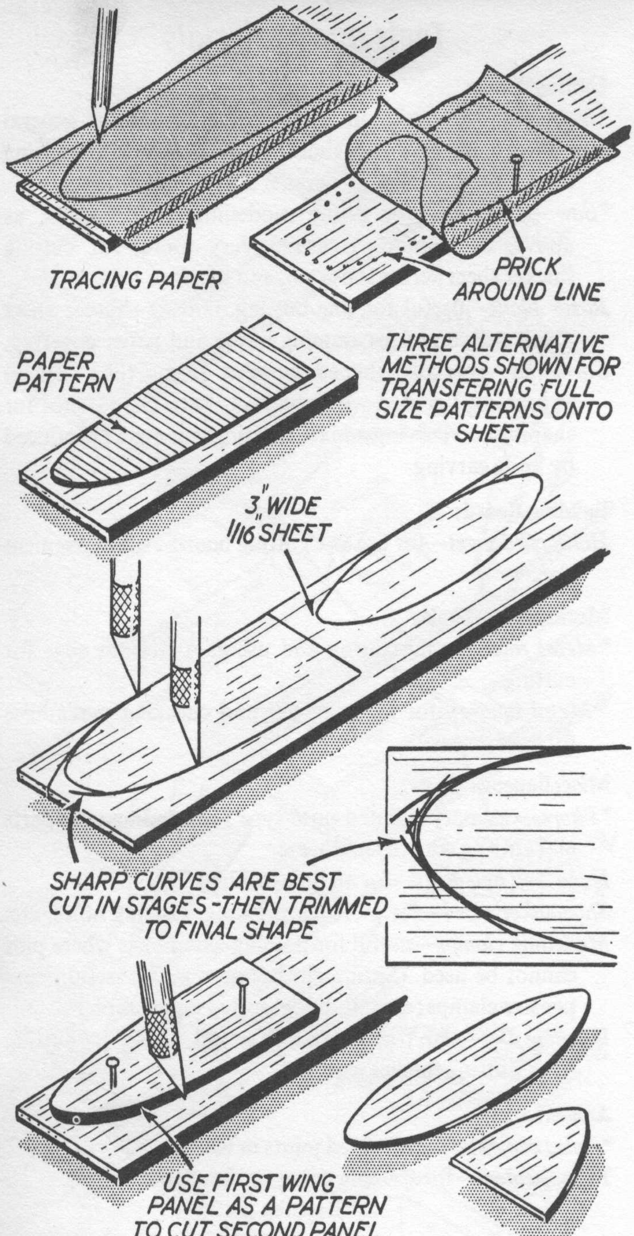
* Essential







Cutting Out Plan Parts



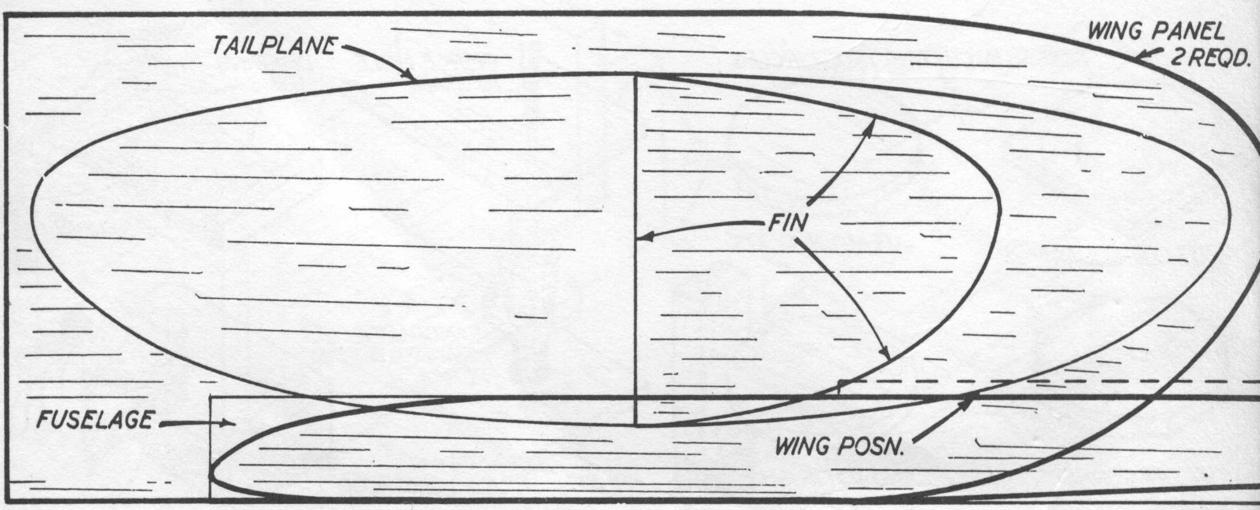
A comprehensive model plan shows all the necessary parts to be cut out either actual size, or to a suitable scale or fully dimensioned so that they can be drawn up actual size. (On model *kit plans* sheet parts are usually printed or die-cut on the sheet wood, so full-size parts drawings are unnecessary.)

Obviously the easiest type of plan to work to is one where all the parts are drawn full size. It is then only necessary to copy the outlines given on to the sheet wood. To avoid damage to the plan the outline should be traced on tracing paper first and then transferred to the sheet. This can be done by laying the tracing paper in position over the sheet, inserting carbon paper underneath and then drawing round the outline again—turning the tracing paper over and drawing over the original pencil lines (the pattern then comes out 'opposite hand')—or transferring the outline on to the sheet by pricking with a pin. In the latter case the pin-pricks on the sheet are joined up with a pencil line as a guide for cutting out.

Another method favoured where an extremely accurate reproduction of shape is required is to transfer the outline on to a piece of thicker paper instead of the wood and cut this out and use as a pattern for cutting round. This is a particularly good method where a number of identical parts have to be cut.

As a useful demonstration of how to mark out full-size patterns on sheet wood, trace the wing, tailplane and fin patterns given below and transfer on to $\frac{1}{16}$-in. sheet by one of the methods just described. When these are cut out they will form the main parts for making a simple all-balsa glider.

Two further tips to note in cutting out—tackle the cutting of sharp curves in stages (rather like cutting circles as described on the previous page). Also, having cut one wing panel you can use this as a pattern for cutting the second, identical panel.



Shaping the fuselage

The fuselage for this model is shaped from a 13-in. length of $\frac{1}{2} \times \frac{3}{16}$-in. strip of hard balsa. Mark on and cut the taper, and also shape the nose. Mark the wing position in pencil.

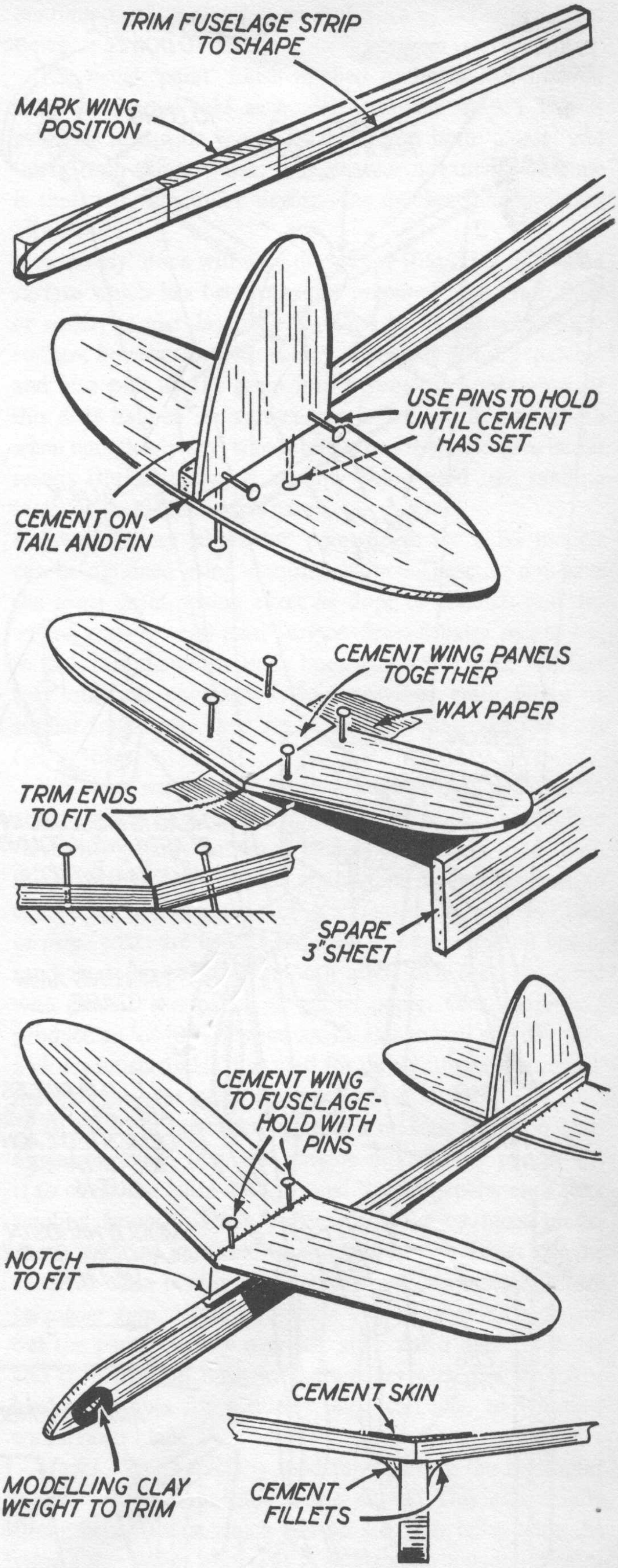
Assembling the model

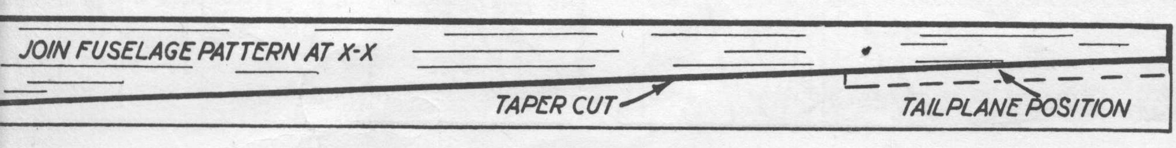
The tailplane is cemented directly to the bottom of the tapered end of the fuselage. Check that the tailplane is properly centred and 'square' with the fuselage and then hold with a couple of pins until the cement has set. The fin cements to one side of the fuselage with the bottom edge resting on the tailplane. This gives a larger gluing area and a stronger joint. Again hold the fin in place temporarily with pins and check with your set-square that it is at right angles to the tailplane.

The two wing panels are cemented together at an angle to give the wing what is called 'dihedral' (very necessary to make the model stable in flight). Pin one wing down flat on a suitable surface such as a building board with a strip of waxed paper under the edge to prevent it sticking to the board when the other wing panel is cemented to it. Offer up the second wing panel with the tip raised 3 in. (e.g. with a spare piece of 3-in. wide sheet supporting the other wing tip above the board). The two wings will not meet in a neat joint and the edges must be trimmed with a knife or saw until they do. Then you can cement them together finally, using pins to hold the second wing panel in position and slipping a piece of waxed paper under the joint line to prevent the wing being stuck down to the building board.

Allow at least an hour for the wing to set. Then it can be unpinned and tried in position on the fuselage. You will have to cut a shallow notch in the top of the fuselage for the wing to seat down properly, which you can easily do with your modelling knife. The fit does not have to be perfect, but the notch should be deep enough to prevent the wing from rocking. Then put a generous coating of cement in the notch and fit the wing in place, holding with pins. Sight from the rear to check that the wings are lined up properly with the tailplane—and also check that they are square with the fuselage.

When this assembly has set, withdraw the pins. You can then add extra strength to the wing joint by building up fillets of cement between the bottom of the wings and the fuselage and also by covering over the top joint with a skin of cement. When this has properly set the model is ready for flying, merely needing plasticine or similar ballast weight adding to the nose of the fuselage to trim. The exact amount of weight required for best results must be found by experiment—adding more weight if the model rears up into a 'stall' and reducing the weight if the model dives.





Easy to Make Puppet

Based on a Schools' model by Solarbo, Ltd., Lancing

This is a model which can give you a lot of fun once made, and also provide more useful practice in the shaping and assembling of simple balsa parts. All the main details should be quite clear from a careful study of the drawing.

Two each of the body parts 'A' and 'B' are required, cut from $\frac{3}{8}$-in. sheet. Cut two 9-in. lengths of $\frac{3}{8}$-in. wide tape or gauze bandage and cement to the face of one of the 'A' blocks, leaving $7\frac{1}{2}$ in. of each tape protruding from the bottom edge. Cement on the second 'A' piece directly over the first. Now cement the two 'B' pieces to the tapes in a similar manner, leaving a $\frac{1}{2}$-in. gap between the two body pieces. The limb pieces ($2\frac{1}{4}$-in. lengths of $\frac{3}{4} \times \frac{3}{8}$-in. strip) are then cemented in pairs to each of the trailing tapes to complete the leg assemblies, as shown on the main drawing.

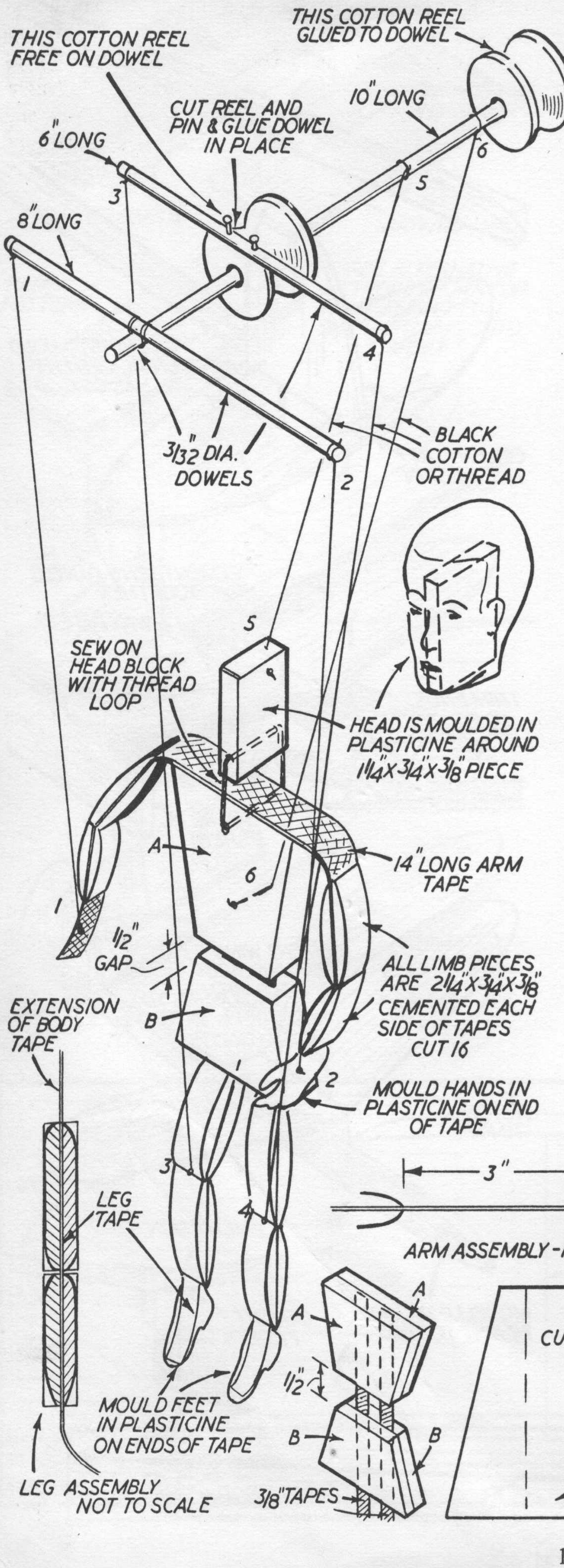
The arms are assembled on a 14-in. length of $\frac{3}{4}$-in. wide tape or gauze bandage, leaving a 3-in. gap in the centre. This length of the tape is then cemented over the 'shoulders' of the model. The head block is then added, consisting simply of a $1\frac{1}{4} \times \frac{3}{4}$-in. piece cut from $\frac{3}{8}$-in. sheet mounted to the body with a thread loop.

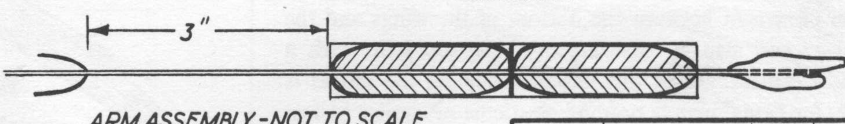
Now cut and trim the limb blocks to a natural shape, providing clearance for bending of the limbs at the joints but remembering that the elbow and knee can only bend one way—flex your own elbow and knee to check which way. Make sure that all the joints flex freely and in a realistic manner.

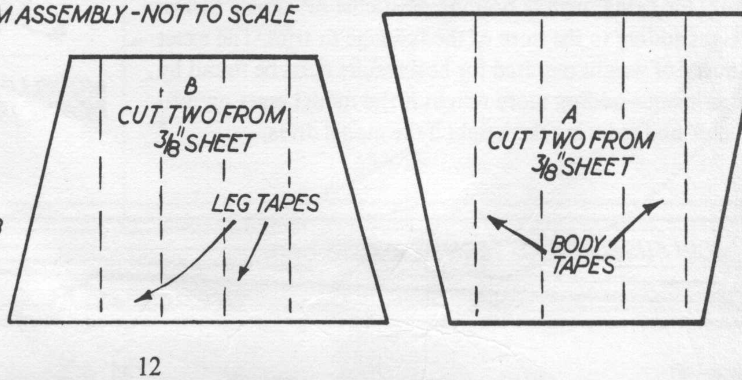
The control stick should be made up next and the control lines attached to the puppet at the points indicated. Finally mould a head in plasticine around the head block and mould plasticine hands and feet on the ends of the arm and leg tapes. Other details such as clothing, etc., can be painted on.

MATERIAL LIST

2 lengths $\frac{3}{4} \times \frac{3}{8}$-in. strip
9×2×$\frac{3}{8}$-in. sheet
24-in. length $\frac{3}{32}$-in. diameter dowel
14—$\frac{3}{4}$-in. tape. 18—$\frac{3}{8}$-in. tape
Plasticine
2 cotton reels







Finishing and Painting Balsa

Being a relatively porous material with an open-grain structure, balsa does not take a paint finish as readily as other woods. A coat of dope or paint, in fact, tends to raise the grain and give a very rough appearance when dry. The only satisfactory way of obtaining a first-class paint finish involves treating the wood with grain filler or sanding sealer and rubbing down perfectly smooth between coats, which can be a long and somewhat tedious process. For most practical purposes, however, a satisfactory finish can be obtained by quicker, easier means.

SANDPAPERING is the main stage in finishing. Sandpaper cuts and removes balsa readily. Grade 2 sandpaper is the coarsest which would normally be ised on balsa and this is sufficiently drastic in its cutting iction to be effective for rough shaping. It is too coarse o get anything like a smooth finish on balsa. Grade 1 sandpaper can be used to remove the cut marks left by coarse anding, followed by the use of grade 0 sandpaper to roduce a good, smooth surface. For a really first-class inish even finer grades—classified as *garnet paper*—are equired. For models which require sanding to finish, but re not being painted, the following recommendations pply:

Use *fine 2* or *middle 2* sandpaper only for 'roughing' to shape, e.g. for such jobs as rounding off the edges and corners of the box described on page 8.

Use *grade 1* sandpaper for general smoothing down, removing knife marks or irregularities or score marks left by coarser sandpaper.

Use *grade 0* sandpaper for final smoothing all over, after all the imperfections have been removed or flatted.

Where the model is to be painted or doped to finish, ollow the same finishing stages to end up with a smooth overall finish. The whole model should then be painted with *rain filler* or *sanding sealer*, using a soft brush. Allow lenty of time for this coat to dry and then sand down uite smooth again with *grade 0* sandpaper or finer *garnet aper*. This process should be repeated as many times as ecessary to produce a really smooth, hard surface free from mperfections. If you are not too worried about getting a erfect paint finish, two coats of filler or sealer will be nough. For a first-class paint job, however, you may eed up to six or eight coats of sealer, sanding down etween each coat. An important point to bear in mind is hat sealer or filler will not cover up imperfections. Unless hese are removed in the initial sanding to finish they will continue to show through as each coat of sealer is rubbed down.

The usual 'paint' finish applied to balsa is a type of cellulose enamel sold as model aeroplane 'dope'. This is available in a wide variety of colours in both 'glossy' and 'matt' (non-shiny) finish. A particular advantage of dope is that it is very quick drying—far quicker than ordinary oil enamels.

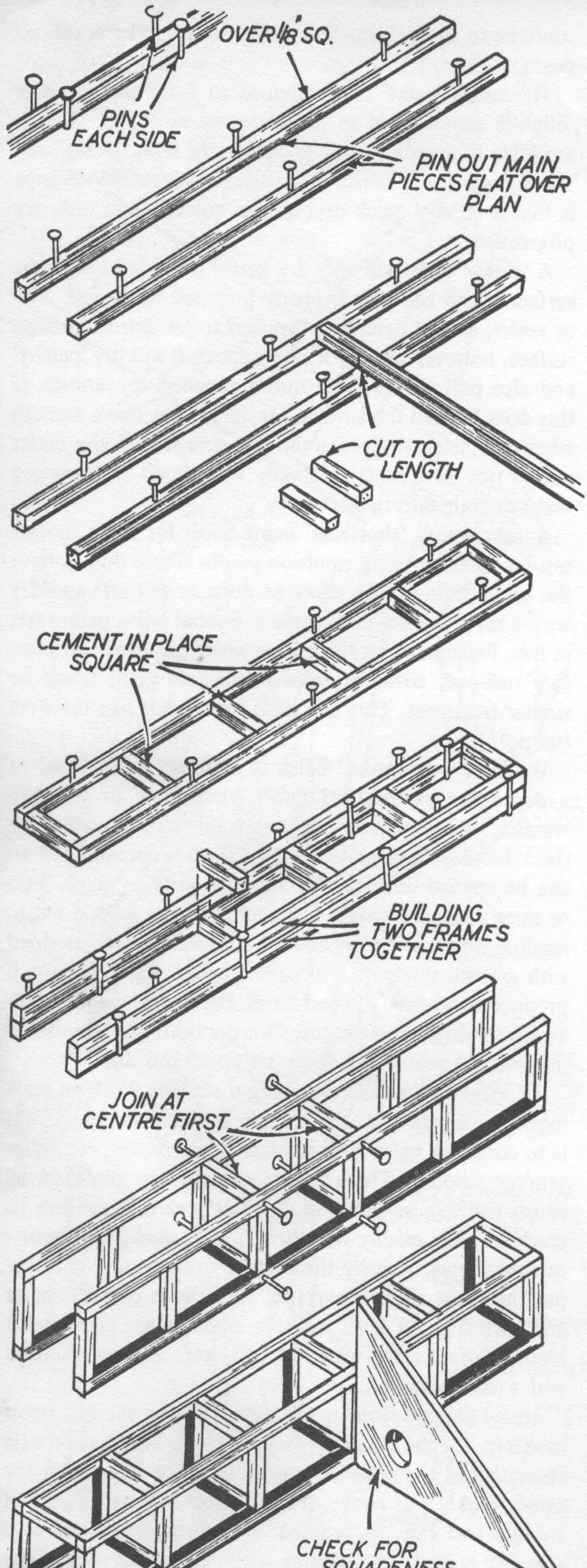
A 'glossy' dope will only dry glossy if applied to a balsa surface which has been properly prepared with grain filler or sealer, as just described. Applied to an untreated balsa surface, however smooth it may appear, it will dry 'patchy' and also pull up the grain into a roughed appearance. If this does happen the surface can be sanded down smooth when completely dry, when the next coat should give better results (the first coat is actually being used like sanding sealer or grain filler in this case).

A satisfactory 'short cut' paint finish for balsa models can be obtained using emulsion paints. These do not have the same grain-raising effect as dope or enamels and dry with a matt or semi-matt surface. Special balsa paints are, in fact, formulated on these lines which give quite satisfactory one-coat coverage *without* previous grain filling or similar treatment. They are ideal for models like the Fort (*see* p. 16).

Where a 'waterproof' finish is required, as opposed to a decorative or coloured finish, clear dope or cellulose 'varnish'—usually known as banana oil—can be used. Both these finishes have certain grain-filling properties and so can be applied directly after the final sanding stage. Two or three coats are usually required to obtain a good finish, sanding down perfectly smooth after each coat has dried with grade 0 sandpaper, or garnet paper. Clear dope will produce an 'ordinary' wood finish. Banana oil will dry with a glossy finish, and is thus used for duplicating a 'varnished' finish on the boat model decks (*see* pp. 26 and 30).

An excellent method of getting a realistic finish on scale model buildings (e.g. the lineside models, *see* pp. 32–37) is to cover the balsa with printed 'brick' papers, etc., after sanding smooth. These papers are sold by most model shops and are available in different scales. Paper can be stuck to balsa readily with *tissue paste*, *photographic paste* or *rubber gum*. Usually the best way of covering is to cut out the paper slightly oversize, stick down over the balsa and then trim off flush with the edges with a sharp razor blade. Cut-outs for windows, etc., can also be trimmed with a razor blade.

Model aircraft tissue is used for covering the helicopter model (p. 15) and the kites (*see* pp. 47–48). This is a specially strengthened tissue which can be stuck to balsa with the same adhesives as above. It is available in a wide range of colours and can be 'proofed' after being stuck on as a covering material by painting with *clear model dope*. Clear dope, however, has a tautening action on tissue when it dries and so would not be used on the kite model coverings as otherwise it would pull them out of shape.



Making Frames

Frames built up from balsa strip are the basis of nearly all model aeroplane structures, particularly fuselages consisting of a box-type structure which is subsequently covered with model aero tissue and doped for strength. In a typical box fuselage the two sides are built as separate frames, then joined with cross pieces called spacers to complete the structure. The same principle of construction holds true whether the side frames are straight and simple in shape, or curved.

Frames are nearly always built directly over a full-size plan or drawing, this being the most convenient way of ensuring accurate assembly. To save parts sticking to the paper, the plan can be covered with a sheet of waxed paper or rubbed over with the end of a candle.

To align the main members over the plan, pins are used. If the wood section is bigger than ⅛-in. square the pins can be pushed right through the balsa without harming it. With smaller wood sizes, however, the pins must be placed either side of the strip to hold it in position.

Having got the main members laid out accurately over the plan the shorter joining pieces—usually of the same section—are cut to the required length. It is quite easy to offer up a length of strip, mark the length required and then cut off accurately to this length. Having cut enough pieces for all joining members these can now be cemented in position to complete the frame. These basic steps are shown in the first three drawings opposite.

Where two identical frames have to be built—e.g. in the case of a model aeroplane fuselage, as previously mentioned—it is usually best to build both sides together one on top of the other to ensure that they are identical. This simply means laying out *pairs* of main members and duplicating each upright member to cement in. The two sides will probably be stuck together when finally removed from the plan but can easily be separated by running a razor blade carefully between them.

In joining frames it is best to join with the centre spacers first—and here you can use pins pushed through the wood to hold these spacers until the cement has set. Then add the remaining spacers, all cut to length measured off the plan. The ends can be held in with rubber bands, if necessary, or pinned again if the wood is thick enough to take a pin without splitting.

A point to watch in completing the assembly is to check that it is true and square, using a set-square to align, if necessary. Similarly the ends can be aligned for 'squareness' to ensure getting a true structure. Books are also useful for lining up and holding simple frame assemblies whilst they are setting. Remember that it is easy to correct any out of squareness when the cement is still tacky, but most difficult once the joints have set.

Simple Helicopters

We can use the simple type of frame construction just lescribed as a fuselage for a model helicopter. The plan given can be scaled to two, three or four times the size as lrawn to make larger models, if preferred, adjusting the naterial sizes accordingly (*see* Table below). The only lifference in this particular fuselage construction is that he end pieces in the two side frames, and the cross joining pieces at each end, are made $\frac{1}{2}$-in. wide and cut from sheet f the same thickness as the longeron size. The simple quare box structure, once completed, is sanded down ghtly and covered with model aero tissue. Cut four panels f tissue slightly oversize and cover each side in turn, ttaching the tissue with tissue cement. Trim the edges of he tissue off with a sharp razor blade and then give the overing two coats of clear model dope.

The fins are cut from sheet balsa, cemented to base piece lso cut from sheet and the joint strengthened with two mall lengths of strip cemented each side (this strip the ame size as the longerons). The rotor hub is slotted with a aw or file at each end to take the sheet rotor blades, which re simply cemented in place. Make sure, of course, that he two blades 'twist' in opposite directions.

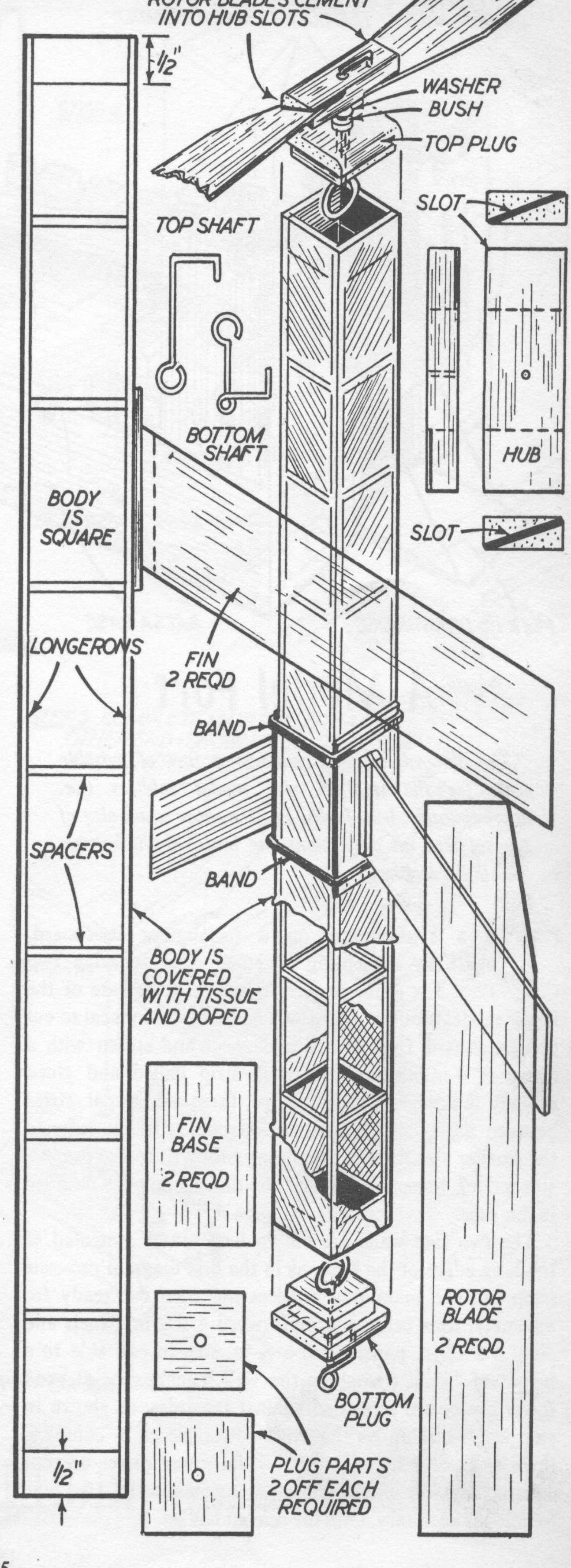
The top and bottom nose plugs are each made by cemenng two sheet parts together. The top plug must be drilled r pierced and fitted with an 18-gauge brass bush to take he top shaft. The bottom shaft can be mounted directly the bottom plug and is locked to it. The loop bend which olds the rubber motor will, of course, have to be comleted after fitting the wire through the plug. Similarly the p shaft will have to be turned over and bent back to ush into the propeller hub after assembly.

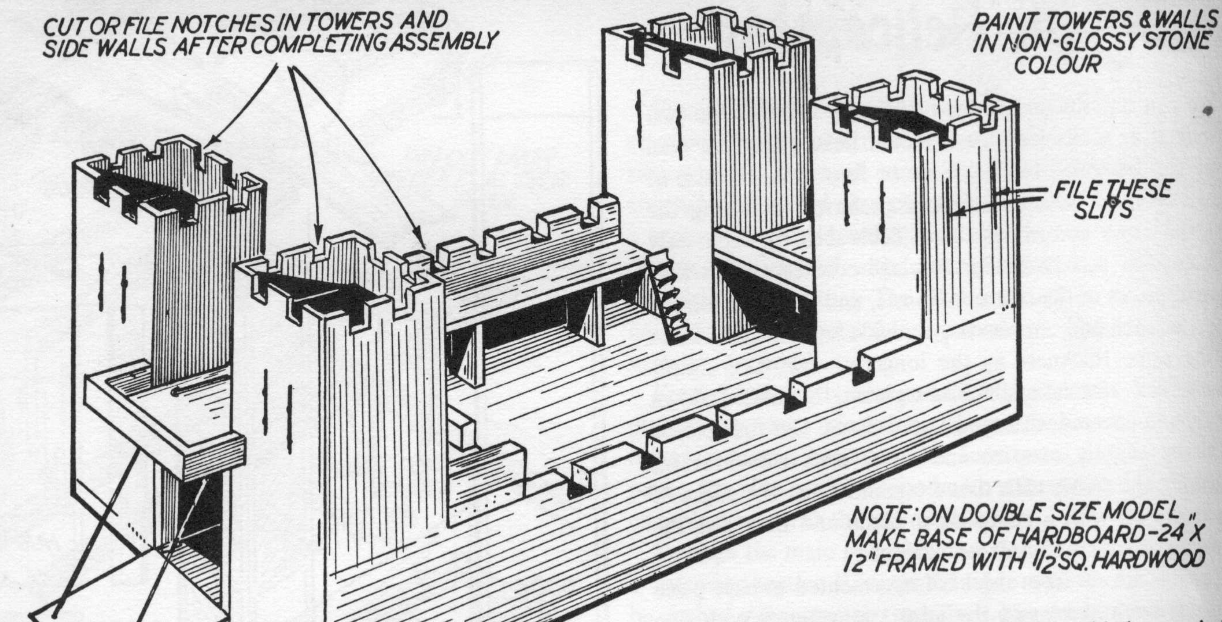
The rubber motor is simply strung between the two shafts, e number of strands required depending on the size and eight of the model. The fins are held on to the side of e fuselage with two rubber bands. They can be slid up d down to find the best position. Start with them about alf way down the fuselage and try the model under about ty hand turns. If the model tends to turn over and dive , move the fins up the fuselage. If the model wallows adly, move the fins down. A few flight tests will soon tablish the best trimming position.

The small model is only suitable for flying indoors. The rgest model should perform satisfactorily out of doors en in a breeze, but as a general rule any model helicopter this layout is usually best flown only in calm air.

TABLE

	Longerons and spacers	*Rotor blades and fins*	*Plug parts*
Same size as plan	$\frac{1}{16}$ sq.	$\frac{1}{32}$-in. sheet	$\frac{3}{32}$-in. sheet
2×plan	$\frac{3}{32}$ sq.	$\frac{1}{16}$-in. sheet	$\frac{1}{8}$-in. sheet
3×plan	$\frac{1}{8}$ sq.	$\frac{3}{32}$-in. sheet	$\frac{1}{4}$-in. sheet





A Model Fort

The dimensions given produce a fort of suitable scale for the smallest size model soldiers (i.e. approximately 1-in. high). For the more usual size of toy soldiers, all dimensions and material thicknesses should be doubled.

THIS is assembled on a rectangular baseboard, made by cementing together edge to edge two $12 \times 3 \times \frac{3}{16}$-in. panels of balsa. In the case of the larger model (double size) it will be more economical to cut this baseboard from hardboard sheet and stiffen with a frame of $\frac{1}{2}$-in. square hardwood strip nailed and glued around the edges, with two or three additional strips between the sides. The instructions which follow refer to the smaller size fort, but apply equally well to the double-size model, remembering that the dimensions are doubled in this case.

The two side walls are cut to length and cemented to the long edges of the base, as in the first diagram opposite (step 1). The main tower pieces are then cut ready for assembly, four being straightforward 4×2-in. panels and eight $4 \times 1\frac{7}{8}$-in. panels with a $\frac{1}{16}$-in. step in one side to a height of $1\frac{1}{2}$ in. (matching the wall height). The stepped tower pieces are cemented against the sides, as shown in step 2, backed up by the other tower pieces to complete three sides of each tower. If all the tower pieces are cut square they will align themselves automatically. Use pins to hold, as necessary, until the cement has set.

The remaining tower pieces are then added—consisting of $1\frac{7}{8}$-in. square panels cemented in the upper part of each tower $\frac{3}{4}$ in. from the top edge, followed by the remaining tower sides which actually rest on the walls and should lie flush with the outside face of the walls when fitted—*see* step 3. When this assembly has set it can be smoothed over with sandpaper.

Two 8-in. lengths of $\frac{1}{2} \times \frac{1}{8}$-in. strip are then cut for the walkways inside the walls, and also six 1-in. lengths of the same size strip for supports for the walkways. The 8-in. strip is cemented between the towers and against the inside of the wall on each side of the fort, as shown in step 4.

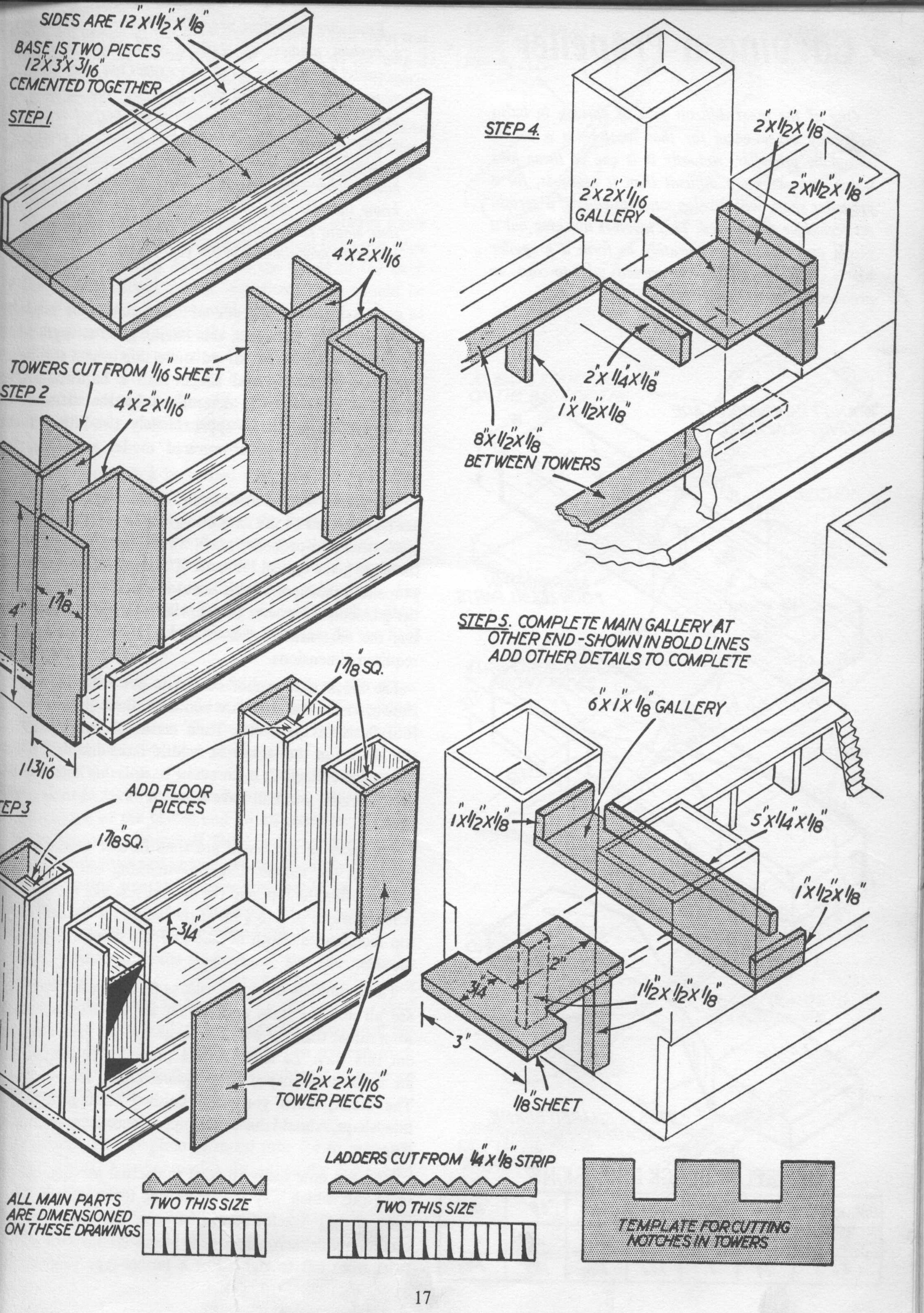
Also in this diagram is illustrated the simple gallery erected to complete one end of the fort. A $2 \times 1\frac{1}{2}$-in. length of $\frac{1}{8}$-in. sheet is cemented between the towers to form a wall and on this is cemented the gallery—a 2-in. square cut from $\frac{1}{16}$-in. sheet. Two-inch lengths of $\frac{1}{2} \times \frac{1}{4}$-in. and $\frac{1}{2} \times \frac{1}{8}$-in. strip are finally added for walls.

At the other end of the fort the space between the towers is left open to form the gateway, but two gateposts ($1\frac{1}{2} \times \frac{1}{2} \times \frac{1}{8}$-in. strip) are cemented to the towers to support the gallery. This gallery is cut from $\frac{3}{8}$-in. sheet in the form of a 'T', the wider portion projecting in front of the towers when assembled. The rear edge is aligned with a $6 \times 1 \times \frac{1}{8}$-in. gallery piece cemented right across the width of the fort resting on the walls each side and tight against the towers (*see* step 5). Again $\frac{1}{2} \times \frac{1}{4}$-in. and $\frac{1}{2} \times \frac{1}{8}$-in. strip lengths are cemented in place to form the sub-walls.

The drawbridge, if fitted, is hinged to the base with tape hinge cemented in place and can be attached to string led up through holes in the gallery.

MATERIAL LIST

$24 \times 3 \times \frac{3}{16}$-in. sheet	$18 \times 2 \times \frac{1}{16}$-in. sheet
$24 \times 3 \times \frac{1}{8}$-in. sheet	1 length $\frac{1}{2} \times \frac{1}{8}$-in. strip
$36 \times 2 \times \frac{1}{16}$-in. sheet	1 length $\frac{1}{4} \times \frac{1}{8}$-in. strip

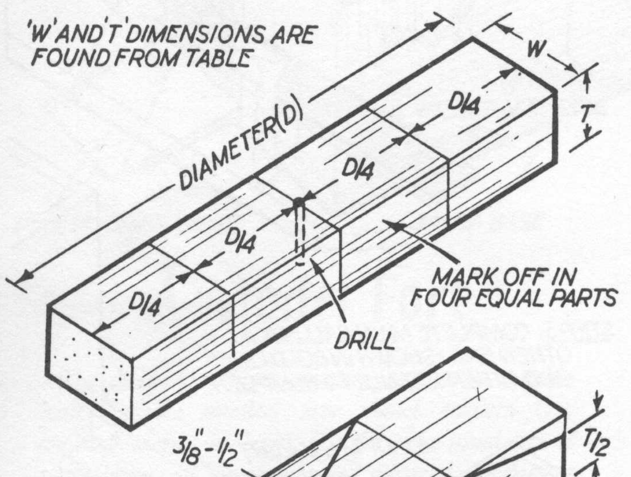


SIDES ARE 12" X 1 1/2" X 1/8"
BASE IS TWO PIECES 12" X 3" X 3/16" CEMENTED TOGETHER
STEP 1.
4" X 2" X 1/16"
TOWERS CUT FROM 1/16" SHEET
STEP 2
4" X 2" X 1/16"
4"
1 7/8"
1 13/16"
1 7/8" SQ.
ADD FLOOR PIECES
STEP 3
1 7/8" SQ.
3/4"
2 1/2" X 2" X 1/16" TOWER PIECES
STEP 4.
2" X 1/2" X 1/8"
2" X 2" X 1/16" GALLERY
2" X 1 1/2" X 1/8"
2" X 1/4" X 1/8"
1" X 1/2" X 1/8"
8" X 1/2" X 1/8" BETWEEN TOWERS
STEP 5. COMPLETE MAIN GALLERY AT OTHER END - SHOWN IN BOLD LINES ADD OTHER DETAILS TO COMPLETE
6" X 1" X 1/8" GALLERY
1" X 1/2" X 1/8"
5" X 1/4" X 1/8"
1" X 1/2" X 1/8"
2"
3/4"
1 1/2" X 1/2" X 1/8"
3"
1/8" SHEET
LADDERS CUT FROM 1/4" X 1/8" STRIP
ALL MAIN PARTS ARE DIMENSIONED ON THESE DRAWINGS
TWO THIS SIZE
TWO THIS SIZE
TEMPLATE FOR CUTTING NOTCHES IN TOWERS

Carving a Propeller

One of the most difficult jobs of carving in balsa —or any other wood for that matter—is a model aeroplane propeller. Actually it is one of those jobs which appears *more difficult than it really is, for a propeller shape will develop automatically if a certain set technique is followed. This involves marking out a* block *and cutting it accurately to form a propeller* blank. *The blank is then carved edge-to-edge to produce a proper propeller shape.*

Producing a perfect propeller by carving demands a certain amount of skill—a skill which is only acquired by practice, so do not expect too much from your first attempts. But every propeller you do carve should bring you one step nearer the perfect article —when you can ultimately produce a piece of craftsmanship of which you can be truly proud. If you build rubber-powered model aeroplanes, too, you will know that the propeller is probably the most important single component of the whole model—and the better the propeller the better your flights.



PROPELLER BLOCK DIMENSIONS

DIAMETER	6"-8"	10"	12"	14"	16"	18"
W	1 1/4"	1 1/2"	1 3/4"	1 3/4"	2"	2"
T	3/4"	1"	1 1/4"	1 3/8"	1 1/2"	1 3/4"

A FAIRLY hard grade of balsa should be used for carving propellers, this having good strength when the blades are carved quite thin whilst still being much easier to cut and shape than a hardwood. The length of the block is determined by the diameter of the propeller required—approximately two-fifths of the wing span of a rubber-powered model aeroplane, for example.

The width (W) and thickness (T) dimensions of the block are then related to the length to give the correct amount of *blade area* and propeller *pitch*. The table at the bottom of the page gives typical 'W' and 'T' dimensions for different propeller diameters. If this is not a 'stock' size of balsa for the particular diameter of propeller you require you must buy the next nearest size up and trim the block to these required dimensions.

The block is then marked out in pencil in quarters, as shown. Use a metal square and draw these lines round all four faces of the block. Then mark the exact centre of the block (on the widest or 'width' face) and drill a hole through the block. It is far easier to drill this hole true and square whilst you still have a square block than at a later stage.

The faces of the block are then further marked off as shown in the second diagram—marking out the bottom face just like the top, and the second side like the first side. Allow a width of $\frac{3}{8}$ to $\frac{1}{2}$ in. at the centre for the hub on the top face, and a depth of one half the block thickness on the side.

These outlines mark the *cutting lines* for the *blank*. They are all straight lines and, as far as possible, should be *sawn* rather than cut with a knife as you can get a straighter cut this way. To carve a true propeller you must have an accurately shaped and *square* blank to start with. The blank, when you have finished cutting it to outline shape, should have the appearance of the bottom diagram.

You are now ready to start the actual carving, but first work out which way the blank has to be carved. For a conventional 'tractor' propeller—e.g. the type normally used on model aeroplanes—the blades are carved to have a twist from left to right. For a pusher-type propeller the

blades are carved in the opposite direction. This does not affect the working of the propeller so much as the way it must be *wound up*, it being easiest to wind up a propeller in a clockwise direction. The two prop-driven models described later (*see* pp. 20–21 and 22–23) should have *pusher-type* propellers carved for them. If they are fitted with a tractor-type propeller, it will have to be wound up 'backwards' to propel the model forwards.

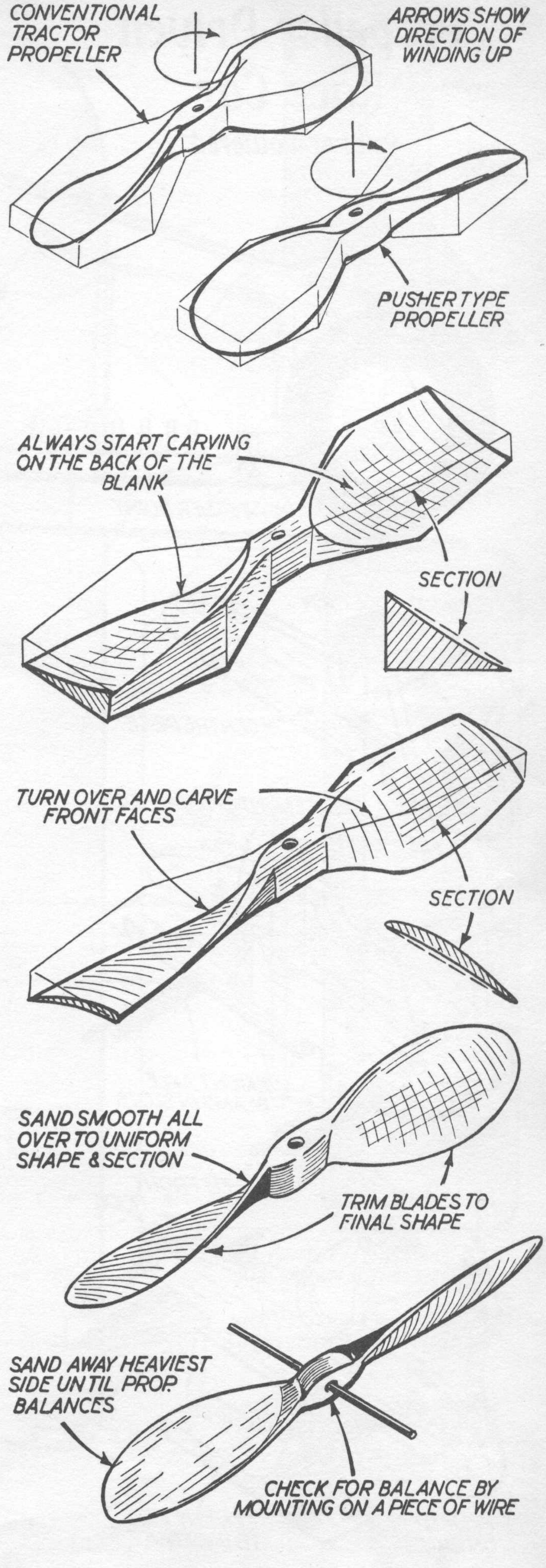
Now for the actual carving stages. Carving always starts on the *back* of the blank, cutting away wood from one edge and gradually working down until the whole of the back of the blade is carved out. A very sharp knife should be used for carving and only small cuts made at a time as otherwise there is a danger of the 'cut running' and removing too much wood from one edge. Each blade back should be carved down, in turn, until you have got a slightly *concave* surface from edge to edge. The final 'surfacing' can be done with fairly coarse sandpaper (e.g. grade 1½ or fine 2).

The blank can then be turned over and the two blade fronts carved, again from edge to edge but this time working to a more rounded surface so that the final blade section is like that shown. Remember that the blades are now getting quite thin and so you cannot bear down heavily on them whilst carving, otherwise you may split them. The nearer you get to the final thinning of the blades the lighter should be the cuts you take. Again you can do the final shaping with sandpaper.

Your propeller will still look fairly rough at this stage. The next thing to do is to shape the outline of one blade to a nice, pleasing curve. Then produce a similar outline on the second blade—using a paper pattern to get the two blade shapes the same, if you cannot judge this accurately enough by eye. Trim away the hub section, too, to blend into the shape of the blades and go all over the propeller with sandpaper to remove all 'flats' and irregularities. The propeller blade thickness should get progressively less from the centre to the tips and the section should be uniform throughout. You can 'feel' the shape of the section by running the blade between a finger and thumb.

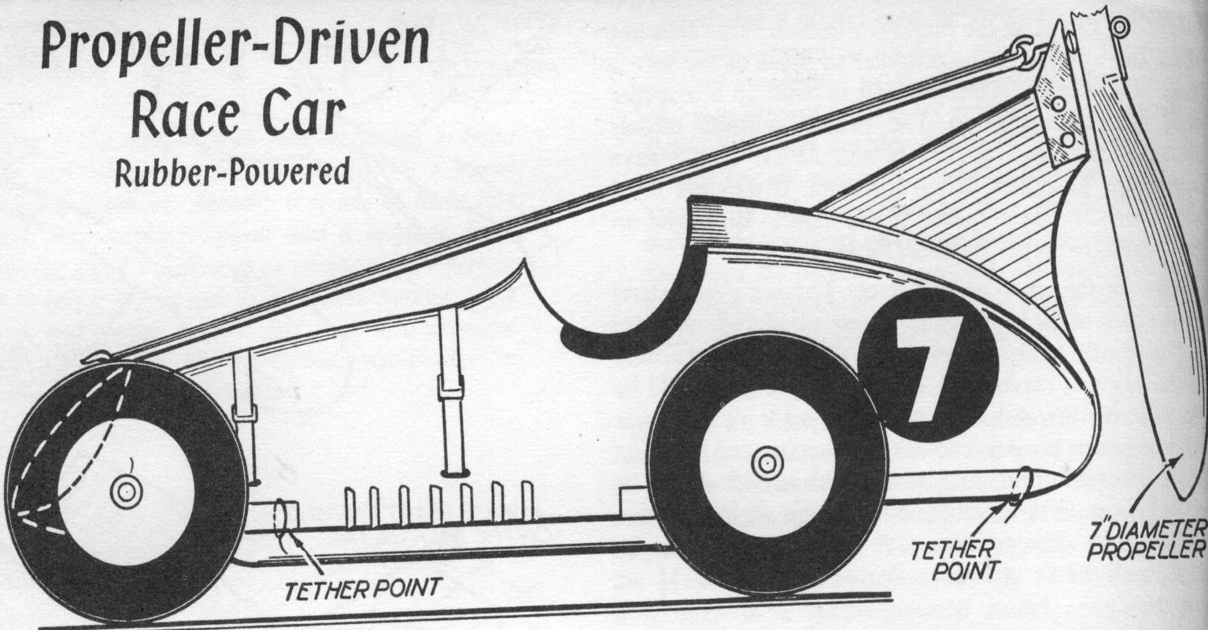
When satisfied with the appearance, slip the propeller on to a length of wire and check for balance. Almost certainly one blade will be heavier than the other, so sand off more wood from the tip of the heavier blade until the propeller will balance level on the wire. Then you can work all over the propeller again with fine sandpaper to produce a really smooth finish.

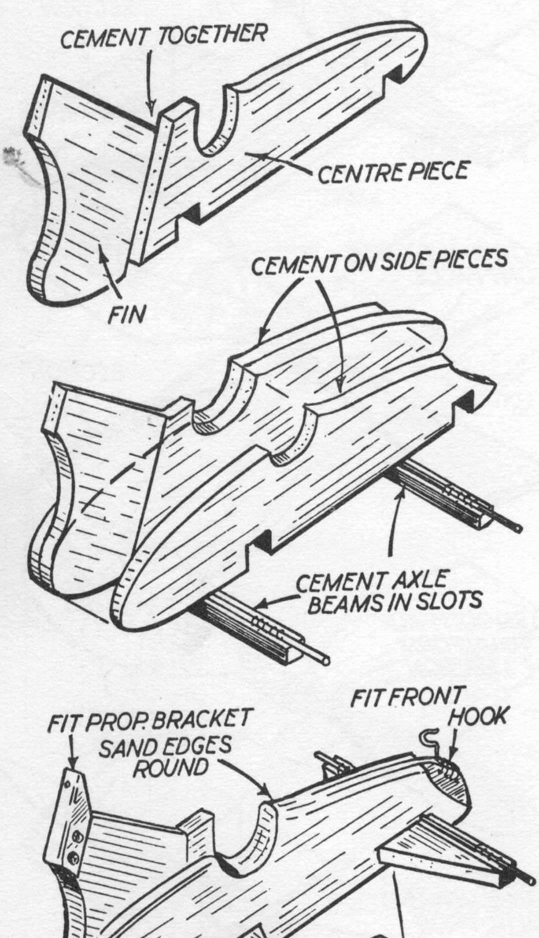
It is always a good idea to bush the centre of a balsa propeller with a short piece of metal tube (or fit a proper threaded bush). Another useful tip, especially for model aeroplane propellers, is to cement a length of thread right round the outline of the propeller blades. This protects the edges against damage and makes the blades less liable to split in a crash.



Propeller-Driven Race Car

Rubber-Powered





A rubber motor is about the most inexpensive way of powering a model and this little race car is capable of 'scale' speeds well in excess of 100 m.p.h. It can be operated on any flat surface or, if you prefer, tethered on a line attached to a suitable 'anchor point' so that it will race round in circles. In the latter case a 9-in. length of line should be tied to each of the tether points 'X' shown and thence to a single line of the required length.

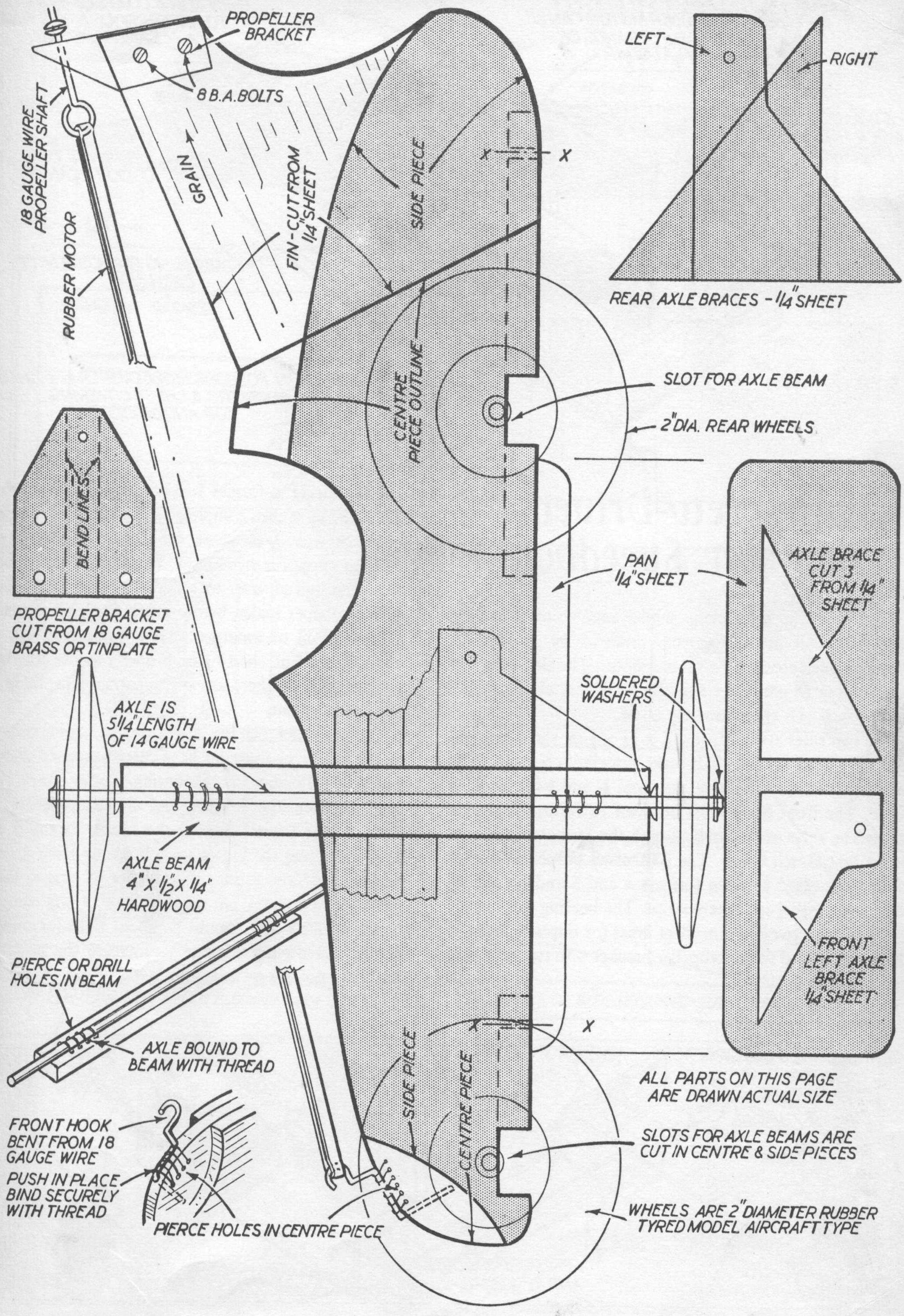
All the patterns on the opposite page are full size. One centre body piece and two side body pieces are cut from $\frac{1}{4}$-in. sheet. The fin piece is also cut from $\frac{1}{4}$-in. sheet, noting particularly the direction of the grain in this case. The centre piece and fin are cemented together, then the two side pieces cemented on (*see* detail sketches).

The axle beams are 4-in. lengths of $\frac{1}{2} \times \frac{1}{4}$-in. hardwoo (e.g. birch or spruce). The $5\frac{1}{4}$-in. long, 14-gauge wire axle are bound to these beams (using a needle and thread) an a washer soldered to the axle at each end of the beam t prevent sideways movement of the wire. The axle beam are then cemented in the body slots, resting the assembl on a flat surface to make sure that they are true and square

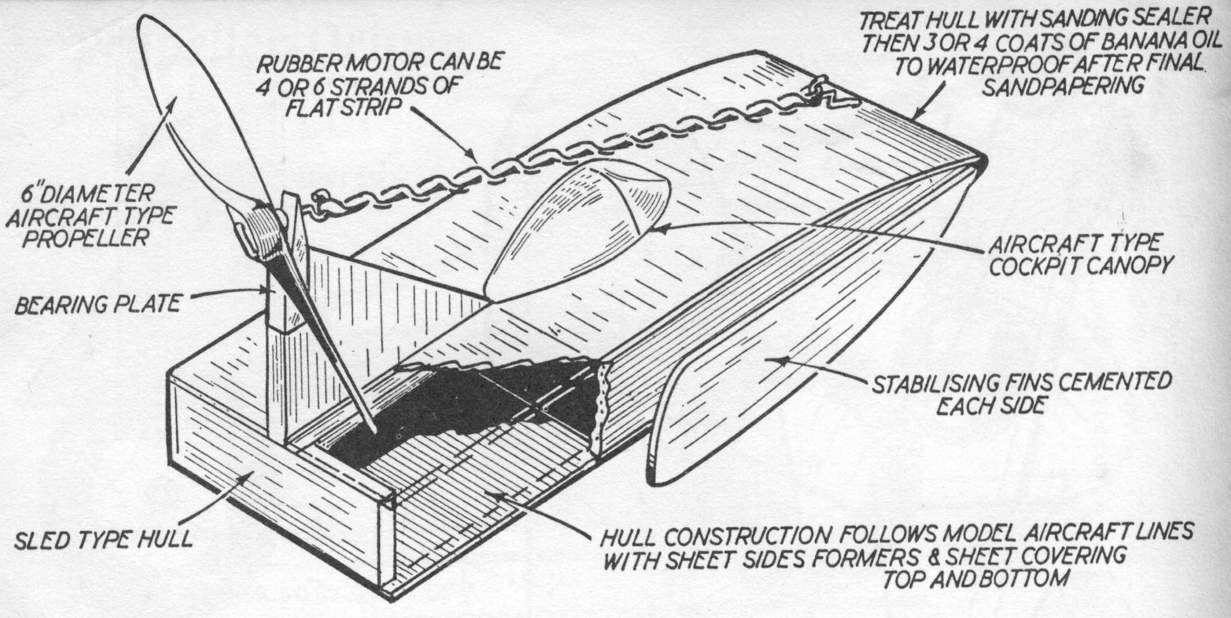
The axle braces, cut from $\frac{1}{4}$-in. sheet, are then cemente in place, finally adding the pan, which cements to th underside of the body. The whole of the body can then b sanded down smooth and the corners rounded off.

The propeller bracket is cut to the pattern given in thi sheet brass or tinplate, bent to fit over the fin and secure with two 8BA-size nuts and bolts. The propeller assemb is quite straightforward, using a 'bought' plastic propell or one carved from balsa (*see* pages 18 and 19). The fro hook for the rubber motor is bent to shape from 18-gaug wire, pushed into the centre body piece and then secure by sewing with thread and finally cementing.

Wheels should be aircraft-type, rubber-tyred with plast or metal hubs. Use $\frac{3}{16}$- or $\frac{1}{4}$-in. rubber strip for the motor- four to six strands.



PROPELLER BRACKET
8 B.A. BOLTS
18 GAUGE WIRE PROPELLER SHAFT
RUBBER MOTOR
GRAIN
FIN - CUT FROM 1/4" SHEET
SIDE PIECE
X
X
LEFT
RIGHT
REAR AXLE BRACES - 1/4" SHEET
CENTRE PIECE OUTLINE
SLOT FOR AXLE BEAM
2" DIA. REAR WHEELS
BEND LINES
PROPELLER BRACKET CUT FROM 18 GAUGE BRASS OR TINPLATE
PAN 1/4" SHEET
AXLE BRACE CUT 3 FROM 1/4" SHEET
SOLDERED WASHERS
AXLE IS 5 1/4" LENGTH OF 14 GAUGE WIRE
AXLE BEAM 4" X 1/2" X 1/4" HARDWOOD
FRONT LEFT AXLE BRACE 1/4" SHEET
PIERCE OR DRILL HOLES IN BEAM
AXLE BOUND TO BEAM WITH THREAD
X
ALL PARTS ON THIS PAGE ARE DRAWN ACTUAL SIZE
FRONT HOOK BENT FROM 18 GAUGE WIRE
PUSH IN PLACE BIND SECURELY WITH THREAD
SIDE PIECE
CENTRE PIECE
SLOTS FOR AXLE BEAMS ARE CUT IN CENTRE & SIDE PIECES
PIERCE HOLES IN CENTRE PIECE
WHEELS ARE 2" DIAMETER RUBBER TYRED MODEL AIRCRAFT TYPE



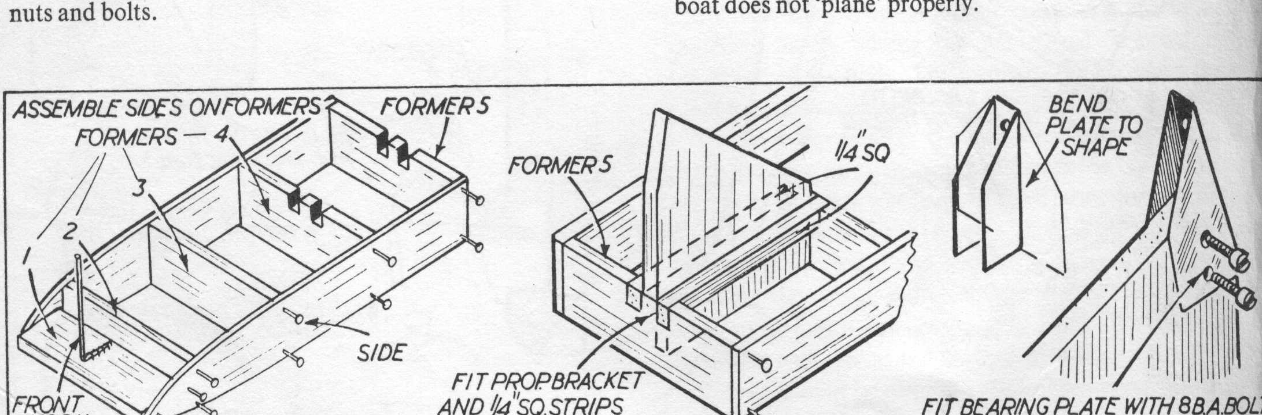
Airscrew-Driven Skimmer Speedboat

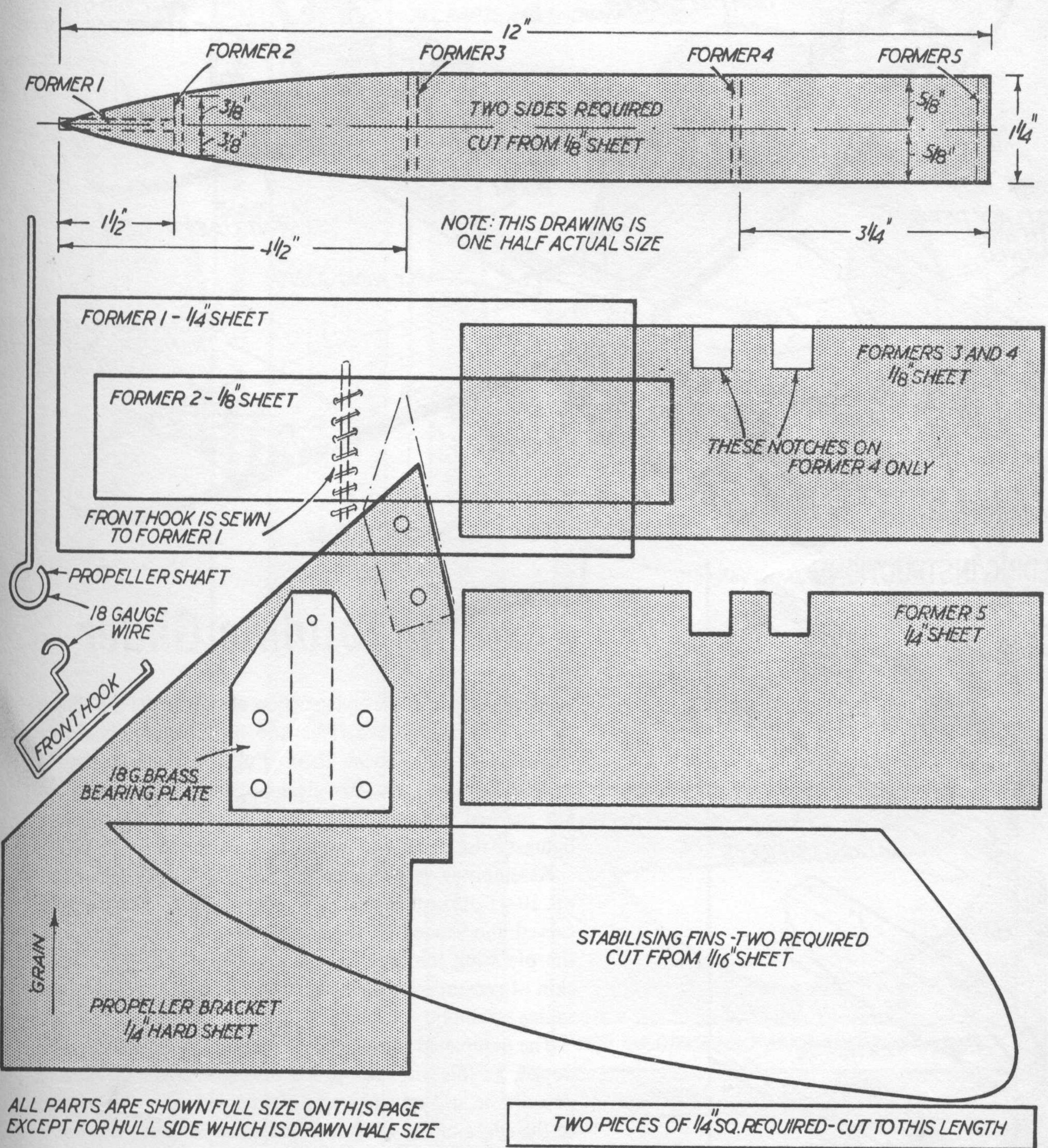
This is a true hydroplane model capable of skimming over the water at high speeds—powered by an aircraft-type propeller driven by a rubber motor. The sled-type hull is very easy to construct and the total cost of the model (less propeller) is approximately 2*s.* 6*d.*

The two sides are cut from $12 \times 1\frac{1}{4} \times \frac{1}{8}$-in. sheet, marked out as shown in the half-scale drawing opposite. The former patterns are full size, cut from $\frac{1}{8}$- and $\frac{1}{4}$-in. sheet, as noted. The front hook must be sawn to former 1 at this stage. The sides are assembled with the formers, as shown in the first sketch below. The $\frac{1}{4}$-in. sheet propeller bracket is then cemented between formers 4 and 5 and braced on either side with $\frac{1}{4}$-in. square strips. The bearing plate is cut to the pattern given in thin sheet brass (or tinplate), bent to shape and bolted to the propeller bracket with two 8BA-size nuts and bolts.

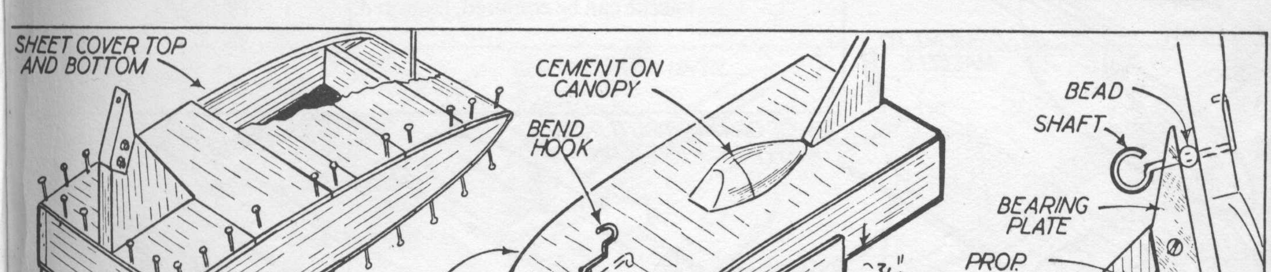
After fairing in former 1 to conform to the shape of the sides the hull is then completed by covering top and bottom with 3-in.-wide $\frac{1}{16}$-in. sheet, cut to 4-in. lengths (or slightly over, to allow for trimming). When thoroughly set, sand down the hull all over to a really smooth finish and treat with sandpaper sealer, before finally applying several coats of banana oil to waterproof. It is important that all the joints on the hull sheeting be properly made, otherwise the hull will leak. If there are any apparent gaps, these can be filled with cement.

The propeller can be a plastic type, obtainable from model shops, or one you have carved yourself from balsa (*see* pages 18 and 19). Mounting is very simple, using a bead between the bracket and the propeller to reduce friction. The front hook for the rubber motor is bent to final shape and the motor itself made up from $\frac{3}{16}$- or $\frac{1}{4}$-in. rubber strip. The greater the number of strands the faster the model will travel, but the shorter the power run. A four- or six-strand motor should be about right for most small ponds, but do not hesitate to increase the power if the boat does not 'plane' properly.

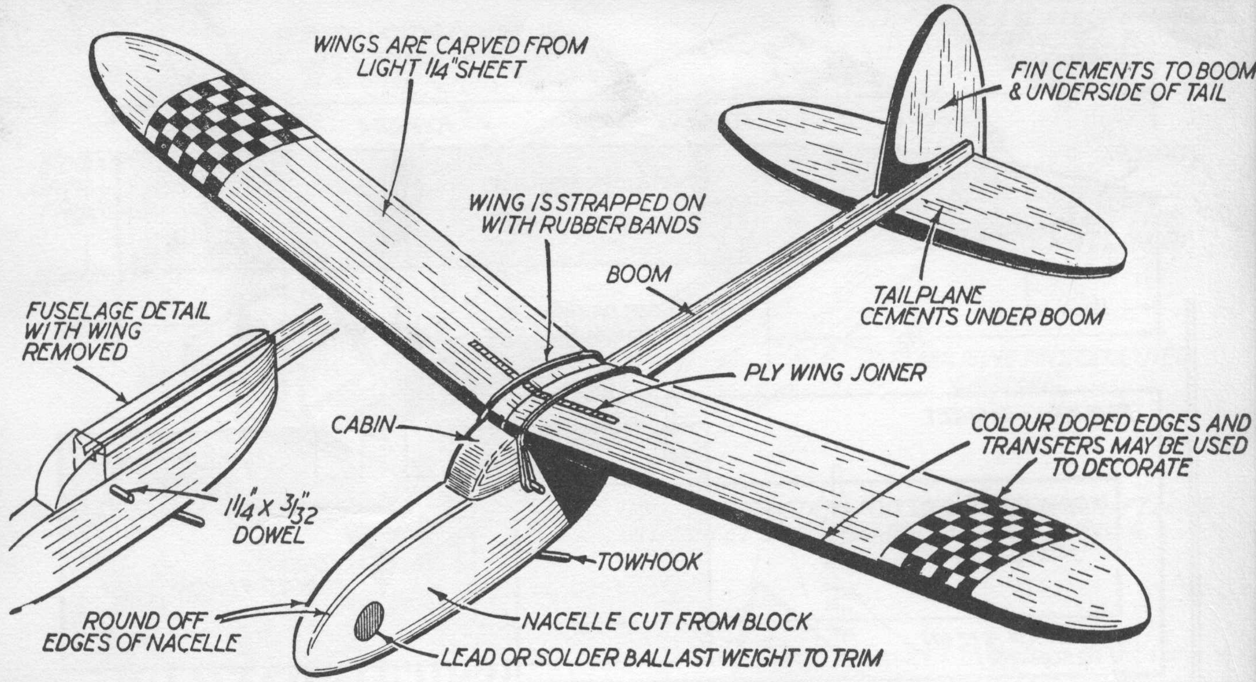




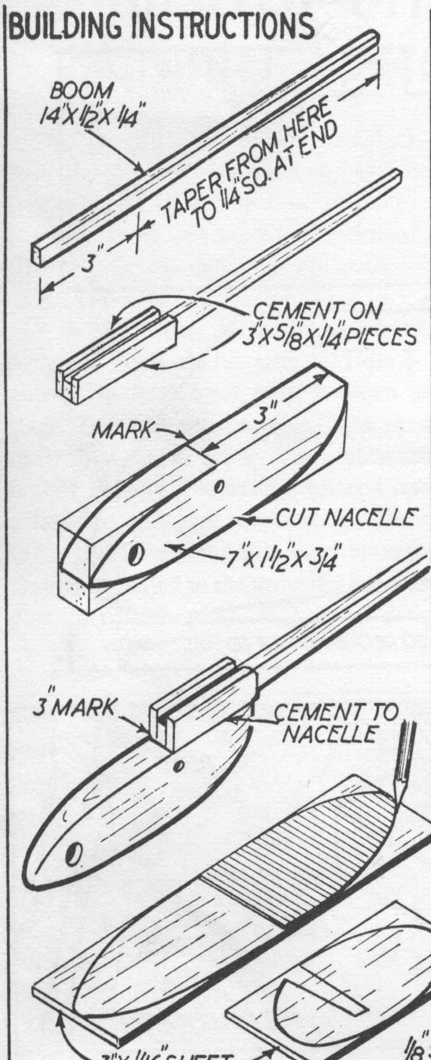
12"
FORMER 1
FORMER 2
FORMER 3
FORMER 4
FORMER 5
3/8"
3/8"
5/8"
5/8"
1 1/4"
TWO SIDES REQUIRED
CUT FROM 1/8" SHEET
1 1/2"
4 1/2"
3 1/4"
NOTE: THIS DRAWING IS ONE HALF ACTUAL SIZE
FORMER 1 - 1/4" SHEET
FORMER 2 - 1/8" SHEET
FORMERS 3 AND 4 1/8" SHEET
THESE NOTCHES ON FORMER 4 ONLY
FRONT HOOK IS SEWN TO FORMER 1
PROPELLER SHAFT
18 GAUGE WIRE
FRONT HOOK
FORMER 5 1/4" SHEET
18 G. BRASS BEARING PLATE
GRAIN
PROPELLER BRACKET 1/4" HARD SHEET
STABILISING FINS - TWO REQUIRED CUT FROM 1/16" SHEET
ALL PARTS ARE SHOWN FULL SIZE ON THIS PAGE EXCEPT FOR HULL SIDE WHICH IS DRAWN HALF SIZE
TWO PIECES OF 1/4" SQ. REQUIRED - CUT TO THIS LENGTH



SHEET COVER TOP AND BOTTOM
HOLD WITH PINS
CEMENT ON CANOPY
BEND HOOK
3/4"
CEMENT ON STABILISING FINS EACH SIDE
BEAD
SHAFT
BEARING PLATE
PROP. BRACKET
PROPELLER MOUNTING



BUILDING INSTRUCTIONS

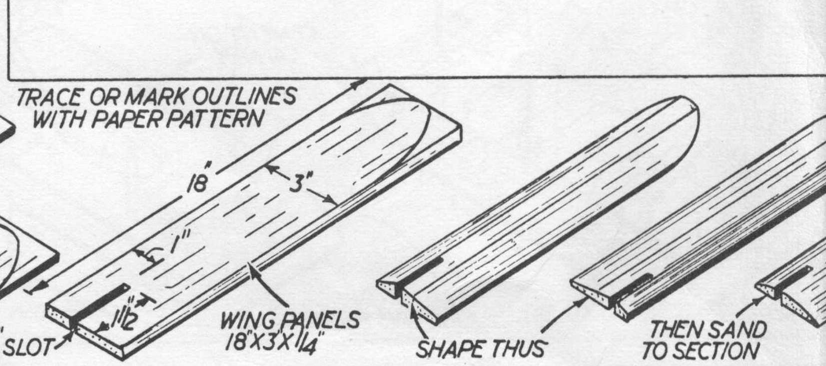


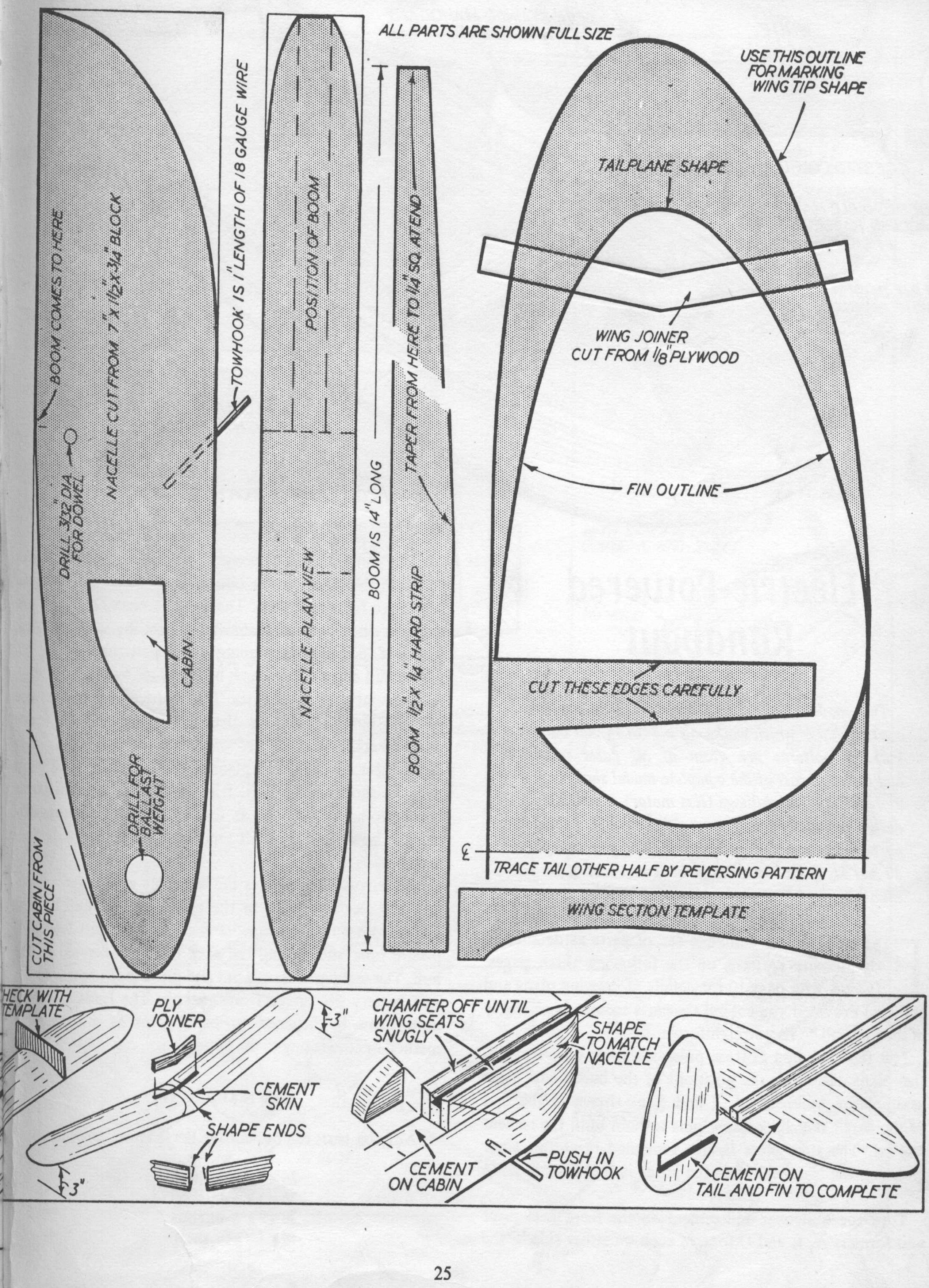
36-in. Towline Glider

All the stages in the construction of this model are shown in the step-by-step diagrams and no difficulty should be experienced in following them. Full-size patterns for the nacelle, tail parts, etc., are given opposite. The wing panels are marked out on $18 \times 3 \times \frac{1}{4}$-in. sheet, choosing the lightest balsa you can in this case.

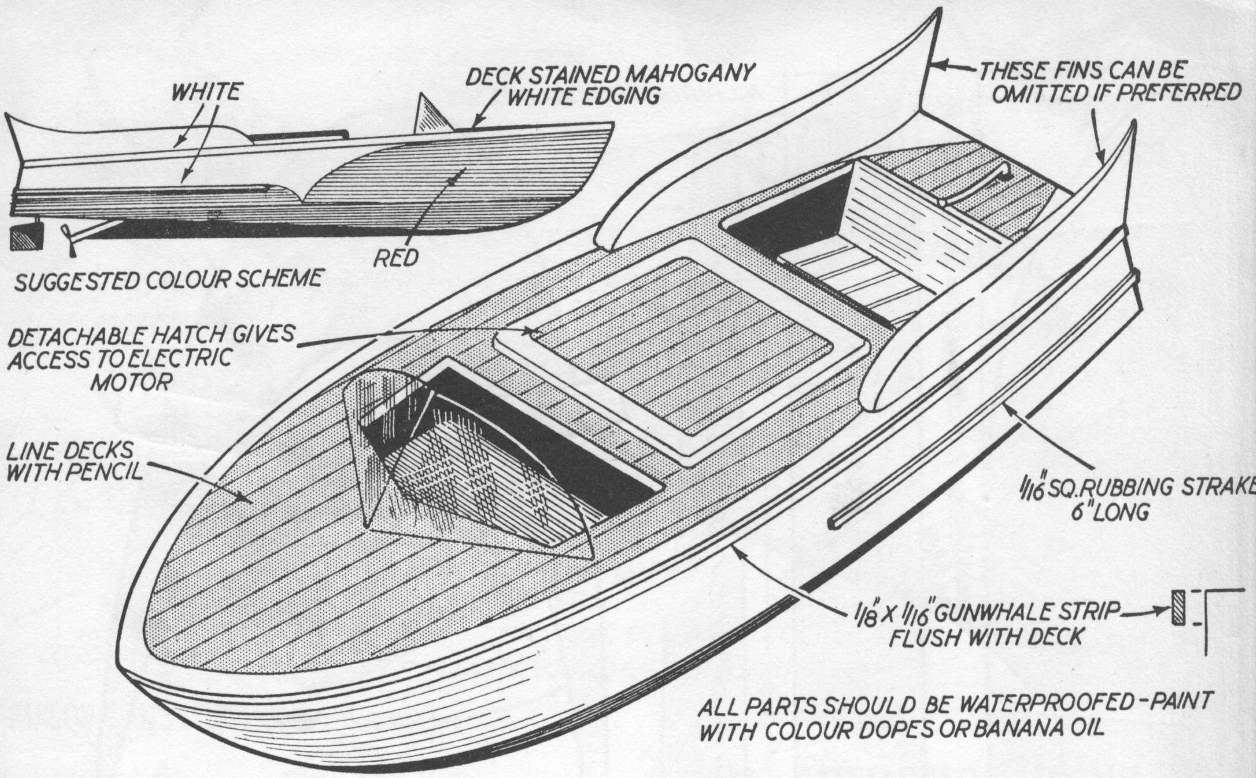
Assembly is very similar to that of the small glider (*see* pp. 10–11), except that in this instance the wings have to be carved and sanded to an aerofoil section. The slot to take the ply wing joiner is best made with a file. A generous skin of cement over the wing joint will give added strength to this assembly.

The completed model should be sanded smooth but *not* doped, as this will add too much weight. If you do want to decorate it, use transfers and restrict any colour dope trim to the edges of the wings and tailplane, although the whole nacelle can be coloured, if desired.





ALL PARTS ARE SHOWN FULL SIZE
USE THIS OUTLINE FOR MARKING WING TIP SHAPE
TAILPLANE SHAPE
WING JOINER CUT FROM 1/8" PLYWOOD
FIN OUTLINE
CUT THESE EDGES CAREFULLY
TRACE TAIL OTHER HALF BY REVERSING PATTERN
WING SECTION TEMPLATE
BOOM COMES TO HERE
NACELLE CUT FROM 7" X 1 1/2" X 3/4" BLOCK
TOWHOOK IS 1" LENGTH OF 18 GAUGE WIRE
DRILL 3/32" DIA. FOR DOWEL
CABIN
DRILL FOR BALLAST WEIGHT
CUT CABIN FROM THIS PIECE
POSITION OF BOOM
NACELLE PLAN VIEW
BOOM IS 14" LONG
TAPER FROM HERE TO 1/4" SQ. AT END
BOOM 1/2" X 1/4" HARD STRIP
HECK WITH TEMPLATE
PLY JOINER
3"
CEMENT SKIN
SHAPE ENDS
3"
CHAMFER OFF UNTIL WING SEATS SNUGLY
SHAPE TO MATCH NACELLE
CEMENT ON CABIN
PUSH IN TOWHOOK
CEMENT ON TAIL AND FIN TO COMPLETE



Electric-Powered Runabout

This model is suitable for powering by any small electric motor which works off a 3- to $4\frac{1}{2}$-volt battery. Full-size patterns are given of all parts required and the total cost of the complete model should not be more than a few shillings (less motor). The basic hull design can also be used for a cabin cruiser, necessary parts and conversion instructions being given on pages 30 and 31. Both boats can be built at a cost of far less than you would normally pay for a kit of one model.

FIRST cut out a complete set of parts as detailed in the full-size patterns on the following three pages. (Check with page 10 for details of copying plans and cutting.) Provided you cut out the parts accurately assembly of the hull will be very straightforward.

Lay the deck and bottom pieces, in turn, over the full-size plans and mark the positions of the bulkheads. Then assemble on bulkheads 1, 2 and 3, as shown in the first of the detail sketches—using pins to hold until the cement has set. The stem piece is also cemented in at this stage and also the transom, after the latter is first chamfered to fit.

Turn the hull over and cement on the front keel piece and formers A, B and C (one of each on either side of the keel). If you are using a 'bought' propeller assembly, inser the stern tube through the bottom slot and cement the rea keel piece tight against it. Then add formers D. If you ar using a 'home-made' propeller assembly, use a $3\frac{1}{4}$-in length of 16-gauge brass tubing for the stern tube.

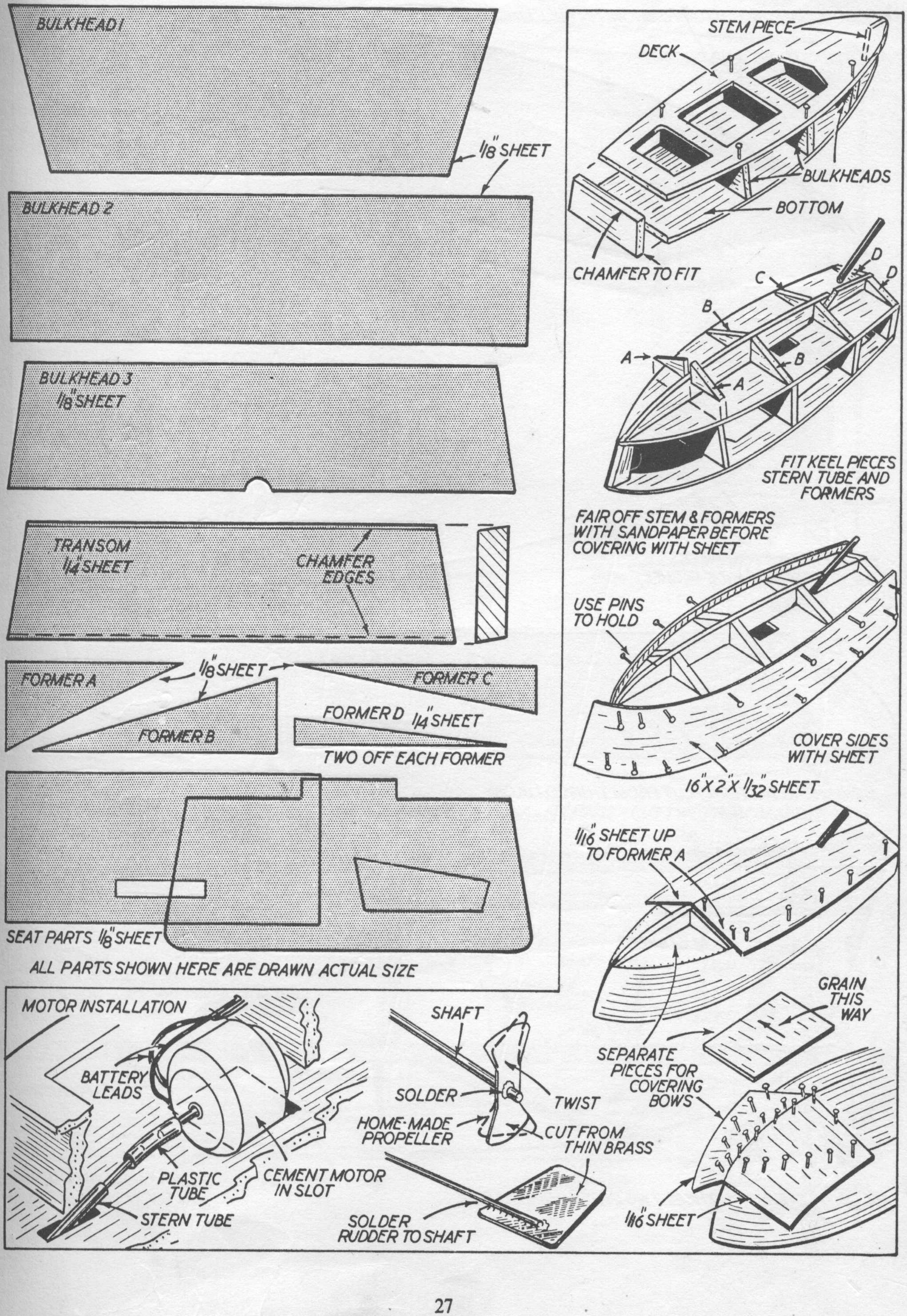
The hull edges should now be faired off by sandpapering ready to take the sheet sides. Take particular care to shap off the stem properly so that the sheet will bed dowr nicely. Each side is then covered, in turn, with a $16 \times 2 \times$ $\frac{1}{32}$-in. sheet, cemented in place and held temporarily wit pins, as shown. When set, trim off flush and sheet cove the bottom—first as far as former A and then complet ing the bow sheeting with separate pieces each side (*se* sketches).

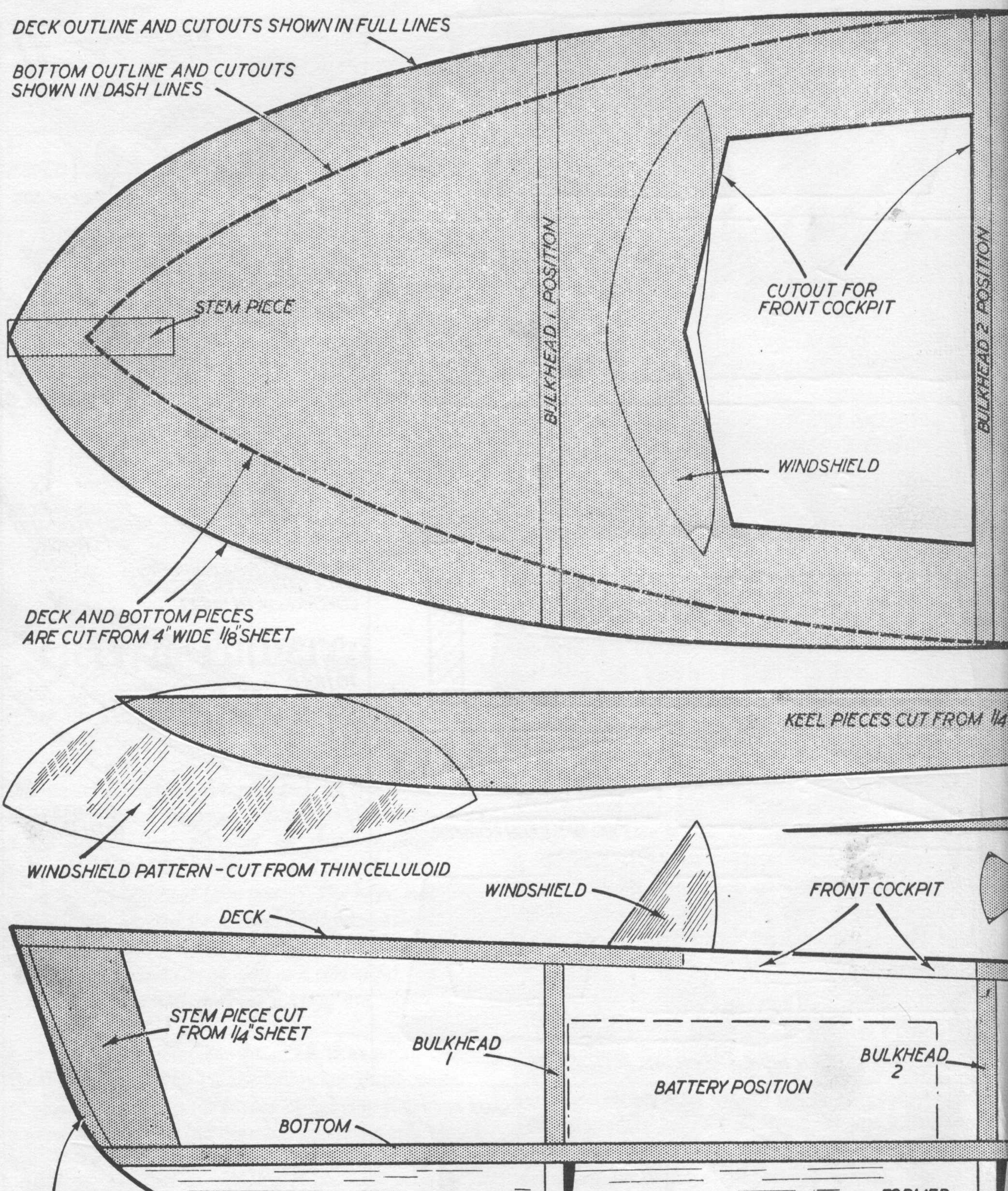
This virtually completes the assembly except for cemen ting the electric motor in the cut-out in the hull bottor and coupling to the propeller shaft with a short length c plastic tube and adding the skeg to the underside of th hull. The seat parts are cut out and fitted in the rear cockpi The battery fits in the front cockpit. The leads from th motor can be fastened to paper clips as a convenier method of connecting to the battery.

MATERIAL LIST

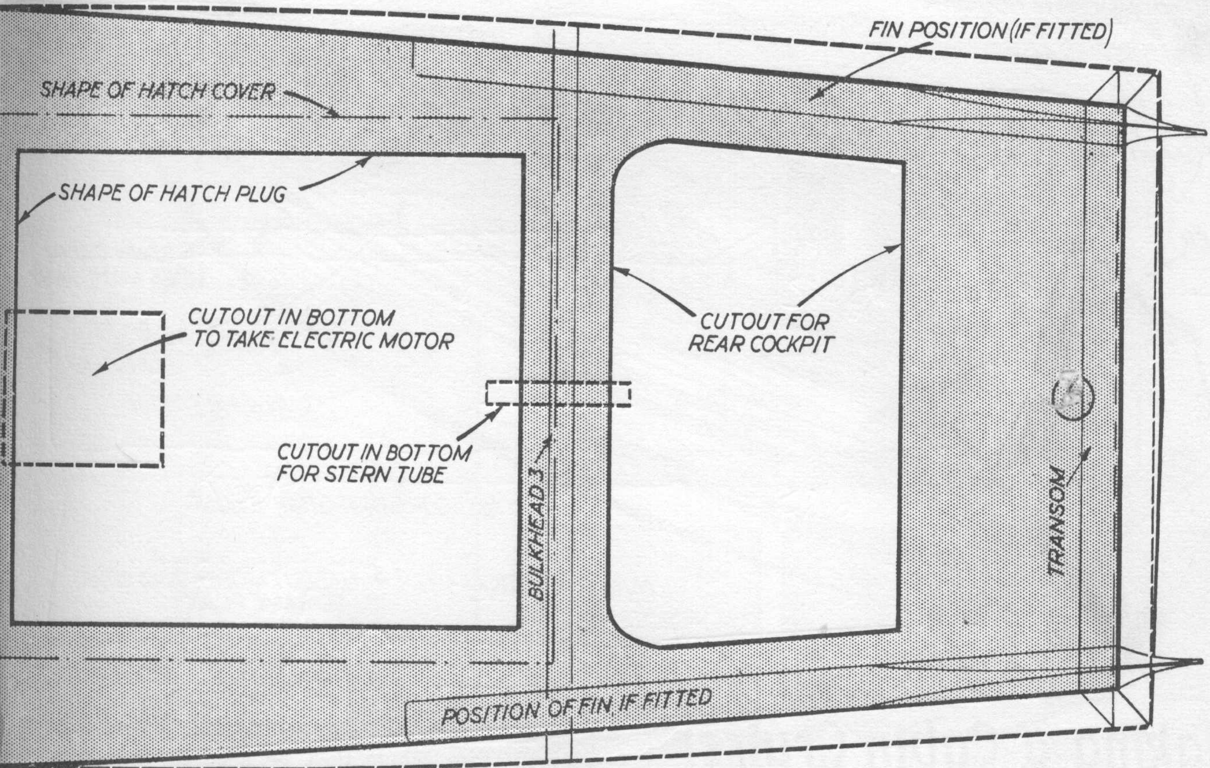
All balsa parts can be cut from the following basic stock:

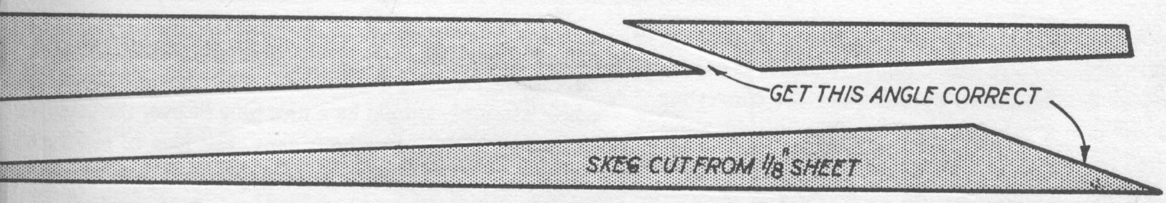
$36 \times 4 \times \frac{1}{8}$-in. sheet
$36 \times 3 \times \frac{1}{16}$-in. sheet
$36 \times 2 \times \frac{1}{32}$-in. sheet
$18 \times 3 \times \frac{1}{4}$-in. sheet

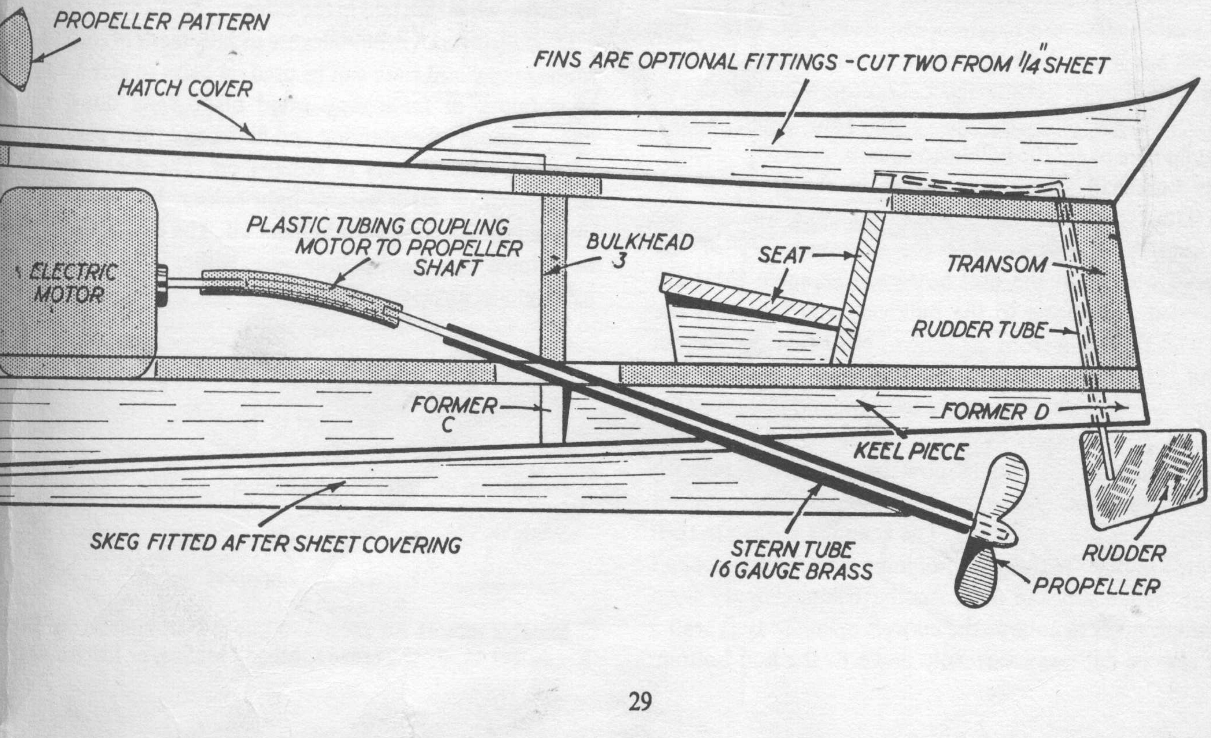

BULKHEAD 1
1/8" SHEET
BULKHEAD 2
BULKHEAD 3
1/8" SHEET
TRANSOM
1/4" SHEET
CHAMFER EDGES
FORMER A
1/8" SHEET
FORMER C
FORMER B
FORMER D 1/4" SHEET
TWO OFF EACH FORMER
SEAT PARTS 1/8" SHEET
ALL PARTS SHOWN HERE ARE DRAWN ACTUAL SIZE
STEM PIECE
DECK
BULKHEADS
BOTTOM
CHAMFER TO FIT
A
B
C
D
FIT KEEL PIECES STERN TUBE AND FORMERS
FAIR OFF STEM & FORMERS WITH SANDPAPER BEFORE COVERING WITH SHEET
USE PINS TO HOLD
COVER SIDES WITH SHEET
16" X 2" X 1/32" SHEET
1/16" SHEET UP TO FORMER A
GRAIN THIS WAY
SEPARATE PIECES FOR COVERING BOWS
1/16" SHEET
MOTOR INSTALLATION
BATTERY LEADS
PLASTIC TUBE
CEMENT MOTOR IN SLOT
STERN TUBE
SHAFT
SOLDER
TWIST
HOME-MADE PROPELLER
CUT FROM THIN BRASS
SOLDER RUDDER TO SHAFT

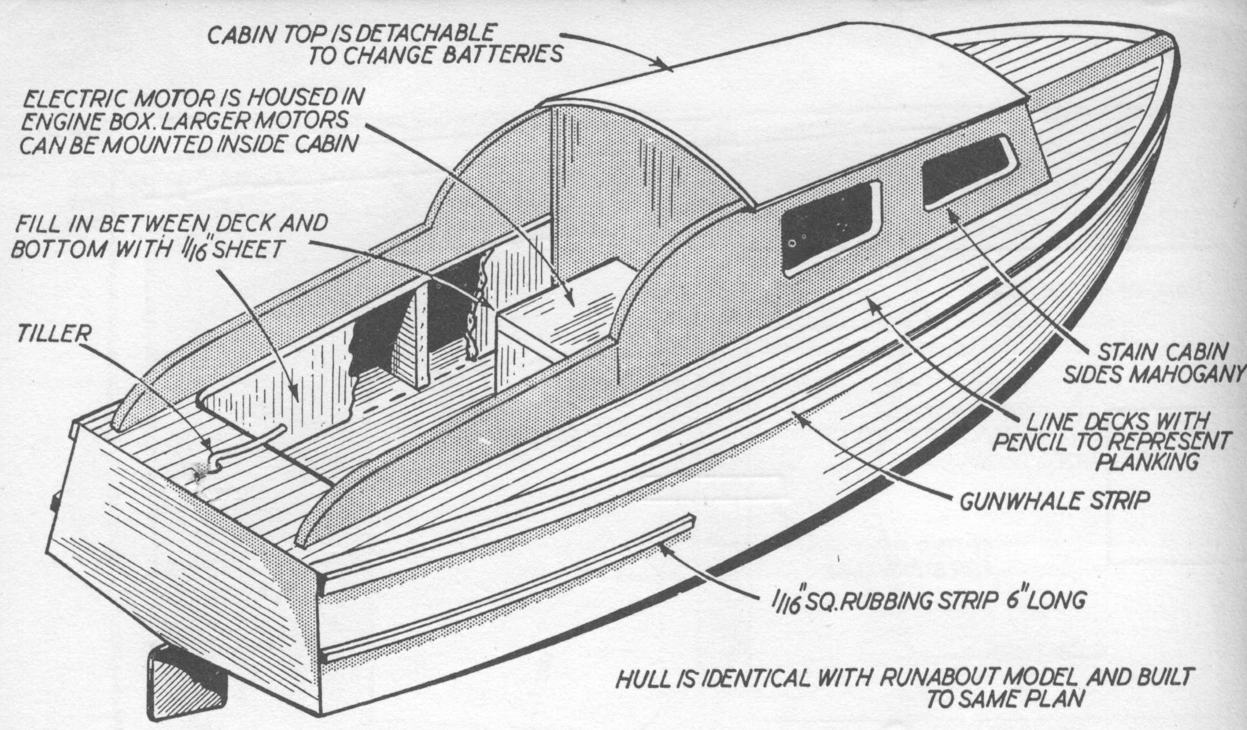


ALL PARTS SHOWN ON THESE TWO PAGES ARE FULL SIZE


FIN POSITION (IF FITTED)
SHAPE OF HATCH COVER
SHAPE OF HATCH PLUG
CUTOUT IN BOTTOM TO TAKE ELECTRIC MOTOR
CUTOUT FOR REAR COCKPIT
CUTOUT IN BOTTOM FOR STERN TUBE
BULKHEAD 3
TRANSOM
POSITION OF FIN IF FITTED


GET THIS ANGLE CORRECT
SKEG CUT FROM 1/8" SHEET


PROPELLER PATTERN
FINS ARE OPTIONAL FITTINGS - CUT TWO FROM 1/4" SHEET
HATCH COVER
ELECTRIC MOTOR
PLASTIC TUBING COUPLING MOTOR TO PROPELLER SHAFT
BULKHEAD 3
SEAT
TRANSOM
RUDDER TUBE
FORMER C
FORMER D
KEEL PIECE
SKEG FITTED AFTER SHEET COVERING
STERN TUBE 16 GAUGE BRASS
RUDDER
PROPELLER



Making a Cabin Cruiser

This model uses exactly the same hull as the electric-powered runabout (full-size plan on the two previous pages). The parts and details shown opposite are for converting the 'runabout' into a cabin cruiser or, alternatively, extra parts required to make a cabin cruiser model in addition to those detailed on the runabout plan.

Two cabin sides are required, cut from $\frac{1}{8}$-in. sheet. The windows are 'glazed' on the inside by cementing on a strip of thin celluloid or acetate sheet. The cabin bulkhead and cabin front are similarly cut from $\frac{1}{8}$-in. sheet, taking particular care to get the bulkhead square.

This bulkhead should exactly fit in the front of the hatch cut-out in the deck of the runabout, the cut-out straddling the motor so that the bottom edges of the bulkhead cement to the hull bottom. The cabin sides are next added, cementing to the bulkhead and joined at the front with the cabin front, as shown. Note that the bottom edge of the cabin front must be chamfered slightly to seat properly on the deck. Pins can be used to hold this assembly until the cement has set.

The electric motor should now be completely encased with the engine-box pieces, the end piece having a cut-out to fit over and clear the drive. The coaming strips are then cemented in place to the decks, aligning over the rear cockpit cut-out. When set, the deck can be trimmed away flush with these strips to enlarge the cockpit opening. Bulkhead 3 must also be cut away vertically down to the hull bottom. The space between the deck and the hull bottom under the coaming strips should then be filled in with pieces of $\frac{1}{16}$-in. sheet cut to fit.

The cabin top is cut from $\frac{1}{16}$-in. sheet to the pattern given. This is mounted on a built-up frame consisting of two bulkheads joined on each side with bracing strips. The whole assembly should be a nice plug fit over the cabin and seat snugly in place without gaps. The idea of making the cabin top detachable is so that you can readily replace batteries, which are laid in the cabin.

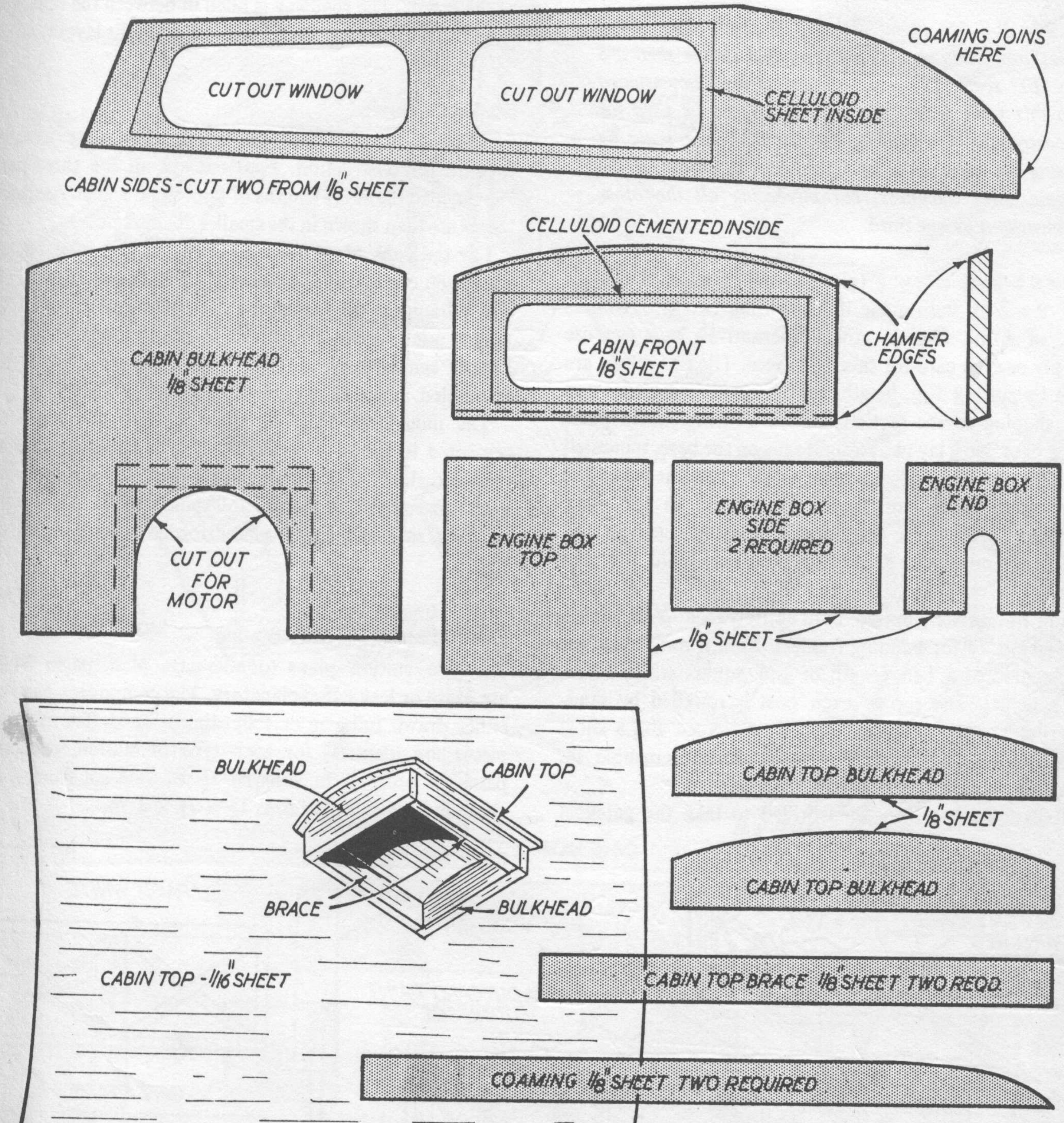
On full-size craft cabin sides are usually made of mahogany. Mahogany wood stain can be used on balsa to give a similar appearance, or mahogany wood filler. Sand down absolutely smooth after staining and filling and then 'varnish' by applying several coats of banana oil. The decks can also be stained, or left a natural light colour, but again waterproofed by painting with banana oil. The cabin top should be painted in a light colour—e.g. white, light blue, etc.—using model aircraft dopes.

MATERIAL LIST

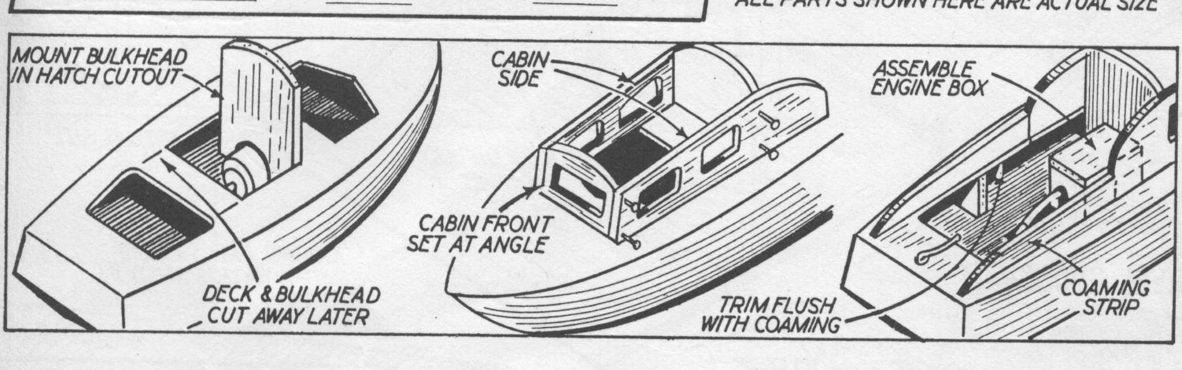
Basic material list as for runabout model:

plus $9 \times 3 \times \frac{1}{16}$-in. sheet
$12 \times 3 \times \frac{1}{8}$-in. sheet

Suitable motors for these two power-boat models are: Ever Ready TG 18, Frog Tornado, Mighty Midget, or Electrotor.



ALL PARTS SHOWN HERE ARE ACTUAL SIZE



Scale Lineside Models

The full-size plans given of a footbridge, island platform, main station platform and engine shed are to 'TT' scale. The level crossing is also dimensioned to this same scale. The same plans can be used for constructing identical models to 00-gauge scale by using the same material thicknesses specified (i.e. the same sheet thickness) but increasing all the other dimensions by one third.

THE level crossing (plan below) is assembled on a 9 × 5-in. base made by cementing two 9-in. lengths of $\frac{1}{16}$-in. sheet together. Alternatively you can use thin ply or even card for this base piece. The end ramps are made by cutting 5-in. lengths off 3-in.-wide $\frac{1}{4}$-in. sheet and then shaping to the section shown. Cement *one* in place on the base. Now lay two straight rails on the base, separated by a 5-in. length of $\frac{3}{16}$-in. square cemented to the base. The other ramp piece can then be cemented to the base, positioned against the second rail. Remove the rails and let the assembly set. Meanwhile you can build the gate frames.

Four frames are required, built entirely from $\frac{1}{16}$-in. square strip (*see* p. 14 for building frames). Each frame, when set, is cemented to a 1-in. length of $\frac{1}{4}$-in. square which forms the gatepost. The top of each post is rounded by sand-papering and the bottom is drilled or pierced and a short length of $\frac{1}{16}$-in.-diameter hardwood dowel cemented in. This dowel should protrude $\frac{1}{4}$ in.

Holes 4 in. apart are then drilled to take the gatepost dowels (*see* main sketch), the gates simply plugging in place in these holes. Trim up the assembly, as necessary, by sanding the end edges of the base to conform to the slope of the ramps. The roadway is filled in between the rails with $\frac{1}{16}$-in. sheet after the crossing is installed on the layout.

Station Footbridge

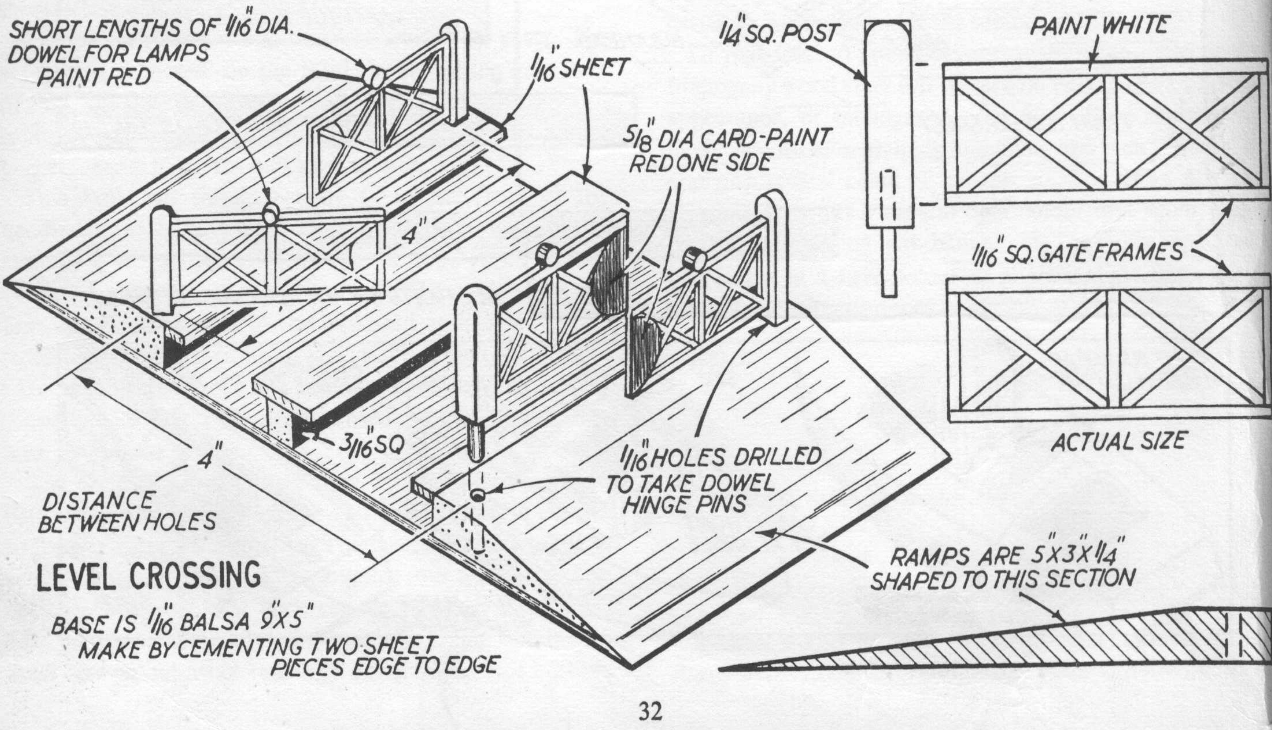
The footbridge (full-size plan opposite) is quite straightforward in construction. First cut out all the sheet parts shown, also the short lengths of $\frac{1}{8}$-in. square strip. Assembly stages are then shown in the smaller detail sketches.

Lay the back piece down on a flat surface after cutting out. Then cement on the pieces A, B and C, as shown. The side pillars are then cemented in place and also two of the longer $\frac{1}{8}$-in. square strips and their shorter cross braces. Finally cement on the front. Two sets of steps are then assembled, as shown in the bottom sketch.

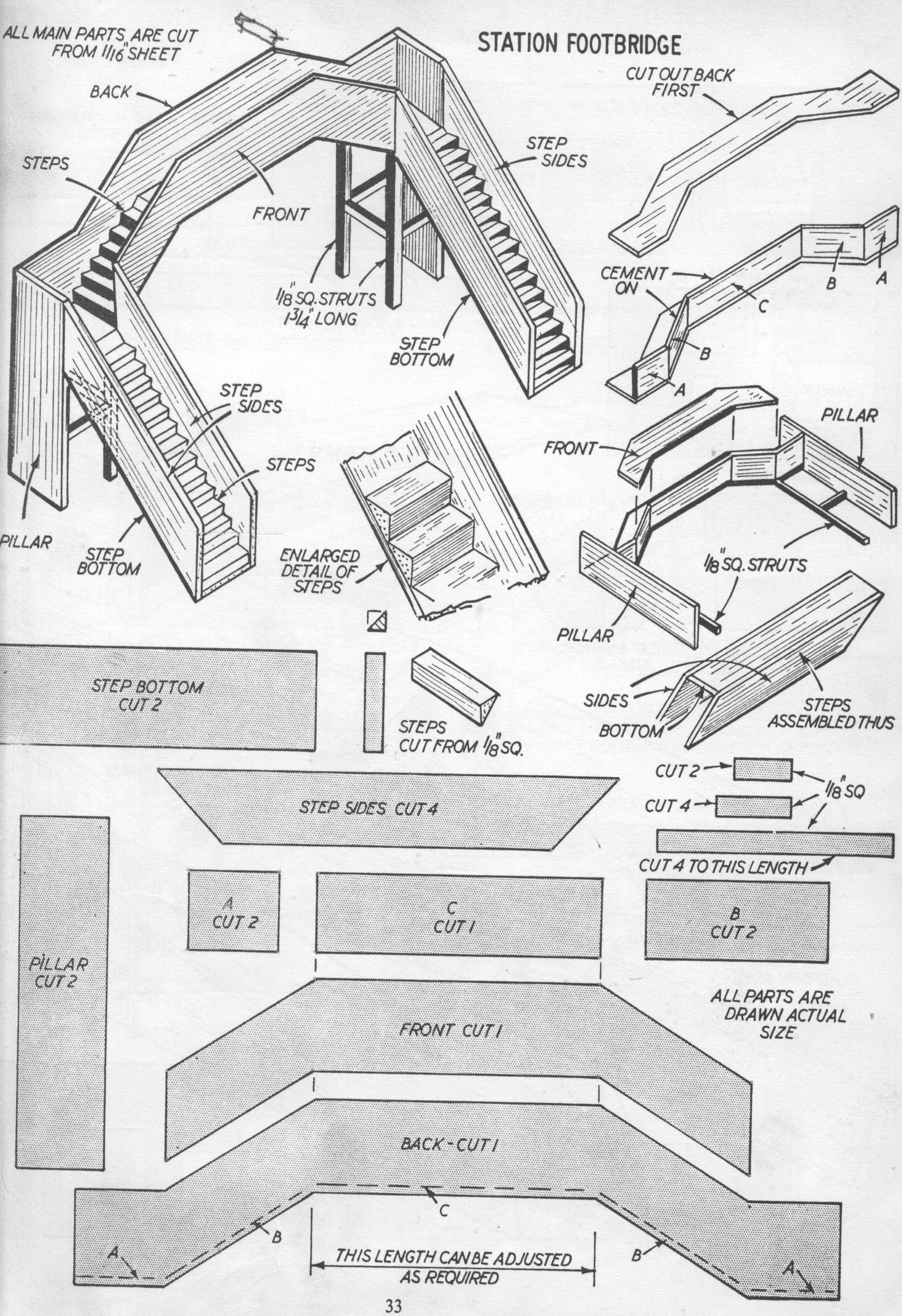
The model can then be stood upright and the steps cemented to the main assembly. The remaining struts are then added. All that remains to do then is to cut forty-two $\frac{1}{8}$-in. square steps, as shown, and cement to the step bottom on each side and the B pieces forming the floor of the bridge.

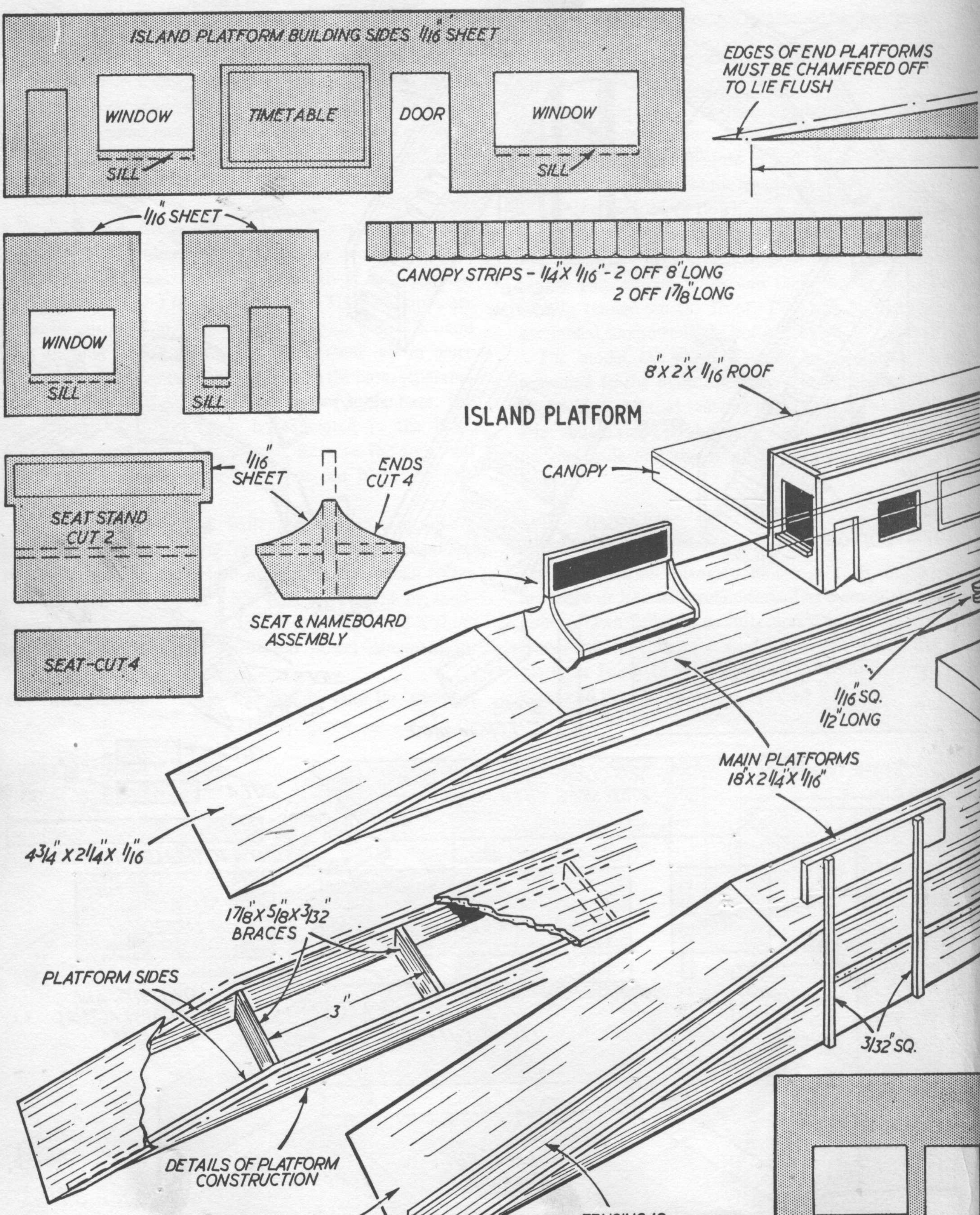
Island Platform and Main Station

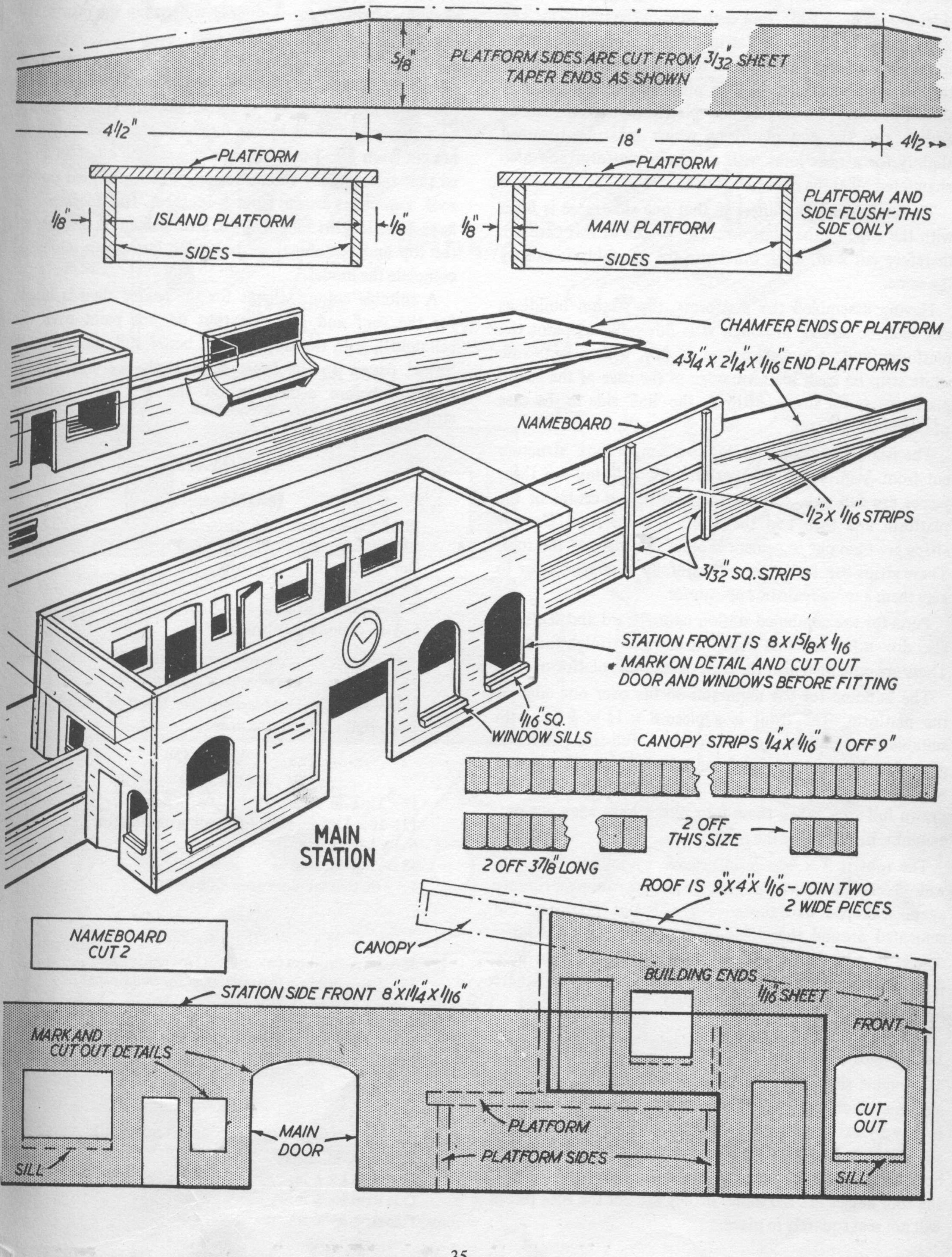
The two station plans (double-page plan, pages 34–35) are more or less self-explanatory. The component parts are either drawn full size or fully dimensioned. The platform pieces are identical for each type of station, the main platform being 18 in. long by $2\frac{1}{4}$ in. wide cut from $\frac{1}{16}$-in. sheet and the end platforms $4\frac{3}{4} \times 2\frac{1}{4} \times \frac{1}{16}$ in.



STATION FOOTBRIDGE




ISLAND PLATFORM BUILDING SIDES 1/16" SHEET
WINDOW
TIMETABLE
DOOR
WINDOW
SILL
SILL
EDGES OF END PLATFORMS MUST BE CHAMFERED OFF TO LIE FLUSH
1/16" SHEET
WINDOW
SILL
SILL
CANOPY STRIPS - 1/4" X 1/16" - 2 OFF 8" LONG
2 OFF 17/8" LONG
8" X 2" X 1/16" ROOF
ISLAND PLATFORM
1/16" SHEET
ENDS CUT 4
CANOPY
SEAT STAND CUT 2
SEAT & NAMEBOARD ASSEMBLY
SEAT-CUT 4
1/16" SQ. 1/2" LONG
MAIN PLATFORMS 18" X 2 1/4" X 1/16"
4 3/4" X 2 1/4" X 1/16"
17/8" X 5/8" X 3/32" BRACES
PLATFORM SIDES
3"
3/32" SQ.
DETAILS OF PLATFORM CONSTRUCTION
FENCING IS 1/2" X 1/16" STRIP
END PLATFORM 4 3/4" X 2 1/4" X 1/16"
1/16" SQ. SILL



5/8"
PLATFORM SIDES ARE CUT FROM 3/32" SHEET
TAPER ENDS AS SHOWN
4 1/2"
18"
4 1/2
PLATFORM
ISLAND PLATFORM
1/8"
1/8"
SIDES
PLATFORM
MAIN PLATFORM
1/8"
SIDES
PLATFORM AND SIDE FLUSH-THIS SIDE ONLY
CHAMFER ENDS OF PLATFORM
4 3/4" X 2 1/4" X 1/16" END PLATFORMS
NAMEBOARD
1/2" X 1/16" STRIPS
3/32" SQ. STRIPS
STATION FRONT IS 8 X 1 5/8 X 1/16
MARK ON DETAIL AND CUT OUT DOOR AND WINDOWS BEFORE FITTING
1/16" SQ. WINDOW SILLS
CANOPY STRIPS 1/4" X 1/16" 1 OFF 9"
2 OFF THIS SIZE
2 OFF 3 7/8" LONG
MAIN STATION
ROOF IS 9" X 4" X 1/16" - JOIN TWO 2 WIDE PIECES
NAMEBOARD CUT 2
CANOPY
BUILDING ENDS 1/16" SHEET
STATION SIDE FRONT 8" X 1 1/4" X 1/16"
FRONT
MARK AND CUT OUT DETAILS
MAIN DOOR
PLATFORM
PLATFORM SIDES
CUT OUT
SILL
SILL

The platform sides are cut from $\frac{3}{32}$-in. sheet as strips $\frac{5}{8}$ in. wide. The total length of each strip is 27 in. Mark in $4\frac{1}{2}$ in. from each end and then cut off at a taper to form the slope for the end platforms. In the case of the island platform the sides are set back $\frac{1}{8}$ in. from each edge of the platform. The spare length of $\frac{5}{8}$-in.-wide strip cut from the 36-in. sheet should be cut to $1\frac{7}{8}$-in. lengths to form braces joining the two platform sides, cemented in place at 3-in. intervals, as shown in the detail sketch. The platform top can then be added, also the end platforms which must be trimmed slightly for a neat joint with the main platform and also chamfered off at the ends to lie flush.

The main platform differs in that one side piece is flush with the edge of the platform. The braces in this case are therefore cut 2 in. long, otherwise the assembly is exactly the same.

Having assembled the platforms, the station buildings can then be added, although it is advisable to paint the platforms first. A typical colour is grey, with a $\frac{1}{4}$-in.-wide white strip on each platform edge in the case of the island platform; and a similar strip on the 'line' side in the case of the main platform.

The island platform building is a simple 'box' structure cut from $\frac{1}{16}$-in. sheet. The patterns for marking out these pieces are full size. Cement in place in the centre of the platform and then add the $8 \times 2 \times \frac{1}{16}$-in. roof. Canopy strips are then cut to cement around the edges of the roof. These strips can be 'scalloped' carefully with sandpaper to give them a more realistic appearance.

Parts for the combined station name-board and seats are also drawn full size and assembly is quite straightforward. These are cemented near the ends of the main platform.

The building for the main station fits over one edge of the platform. The front is a piece $8 \times 1\frac{5}{8} \times \frac{1}{16}$ in. with suitable door and window cut-outs. A full-size pattern is given for the 'station side' front, which also has door and window cut-outs. The pattern for the end shape is also drawn full size. When these four pieces have been cut out, assemble directly over the platform.

The roof is $9 \times 4 \times \frac{1}{16}$ in.—made by joining two 2-in. wide sheets if you have no 4-in. sheet. The canopy strips are again scalloped like those of the island platform and cemented around the edges of the roof. The only other details to add then are the fencing pieces cut from $\frac{1}{2} \times \frac{1}{16}$-in. strip and the name-boards erected on $\frac{3}{32}$-in. square strips.

Engine Shed

The engine shed is another simple accessory to make and also one which can readily be extended in length, if required, merely by extending the number of bays in the sides. The side pattern should be traced on to $\frac{1}{8}$-in. sheet and cut out accurately. Cut two sides and place together to check that the roof angles are the same. If they are not the roof pieces will not seat squarely in place.

The skylight pieces incorporate window cut-outs which must be made carefully to aviod splitting the wood. Each skylight is then backed with a piece of thin celluloid cemented in place to represent glass. Note that the front skylight—skylight A—is slightly wider than the others. All the roof pieces are cut the same size.

The easiest way to assemble the model is to cement on one roof piece at each end—*see* detail sketch—holding with pins until the cement has set. Then add the two remaining roof pieces, followed by the four skylights. The chimneys are cut from $\frac{3}{8} \times \frac{1}{4}$-in. strip, one end shaped off at an angle so that the chimney stands vertical when cemented on the roof. Top pieces are cut from $\frac{1}{16}$-in. sheet. The side windows have $\frac{3}{4}$-in. lengths of $\frac{1}{8} \times \frac{1}{16}$-in. strip cemented in place at the top and bottom, these being the last pieces added to complete the model.

A suitable colour scheme for the engine shed is black, for the roof and skylights (but do not paint over the celluloid!), with the sides red or, better still, covered with 'brick' paper. In the latter case, apply the brick paper covering before cementing on the $\frac{1}{8} \times \frac{1}{16}$-in. window strips.

MATERIAL LIST

LEVEL CROSSING

$18 \times 3 \times \frac{1}{16}$-in. sheet
$10 \times 3 \times \frac{1}{4}$-in. sheet
One length $\frac{1}{16}$-in. square strip
$4 \times \frac{1}{4}$-in. square strip
5–$\frac{3}{16}$-in. square strip
6–$\frac{1}{16}$-in. diameter hardwood dowel

STATION FOOTBRIDGE

9–$12 \times 3 \times \frac{1}{16}$-in. sheet (depending on length of bridge)
Two lengths $\frac{1}{8}$-in. square strip

ENGINE SHED

$18 \times 3 \times \frac{1}{16}$-in. sheet
$12\frac{1}{2}$–$18 \times 3 \times \frac{1}{8}$-in. sheet (depending on length of shed)
6–$\frac{3}{8} \times \frac{1}{4}$-in. strip
$15 \times \frac{1}{8} \times \frac{1}{16}$-in. strip
4×3-in. thin celluloid or acetate sheet

PLATFORMS (both station models)

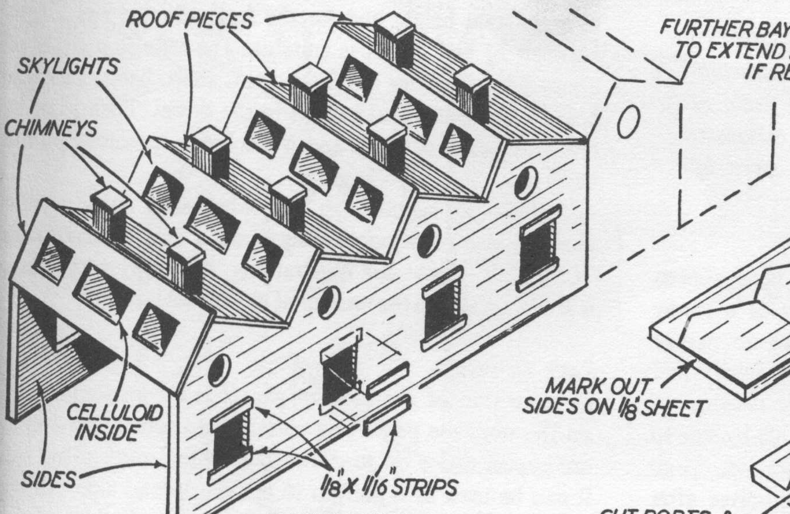
$36 \times 3 \times \frac{3}{32}$-in. sheet (enough for two platforms)
$36 \times 3 \times \frac{1}{16}$-in. sheet (material over for buildings)

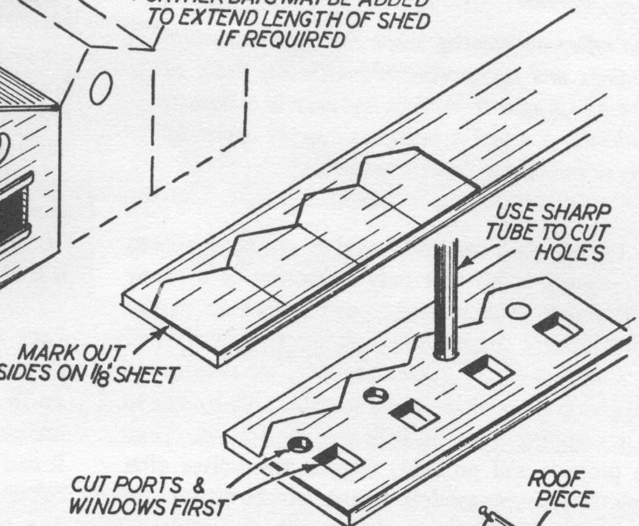
ISLAND PLATFORM (additional materials)

$12 \times 3 \times \frac{1}{16}$-in. sheet
One strip $\frac{1}{4} \times \frac{1}{16}$ in.

MAIN STATION (additional materials)

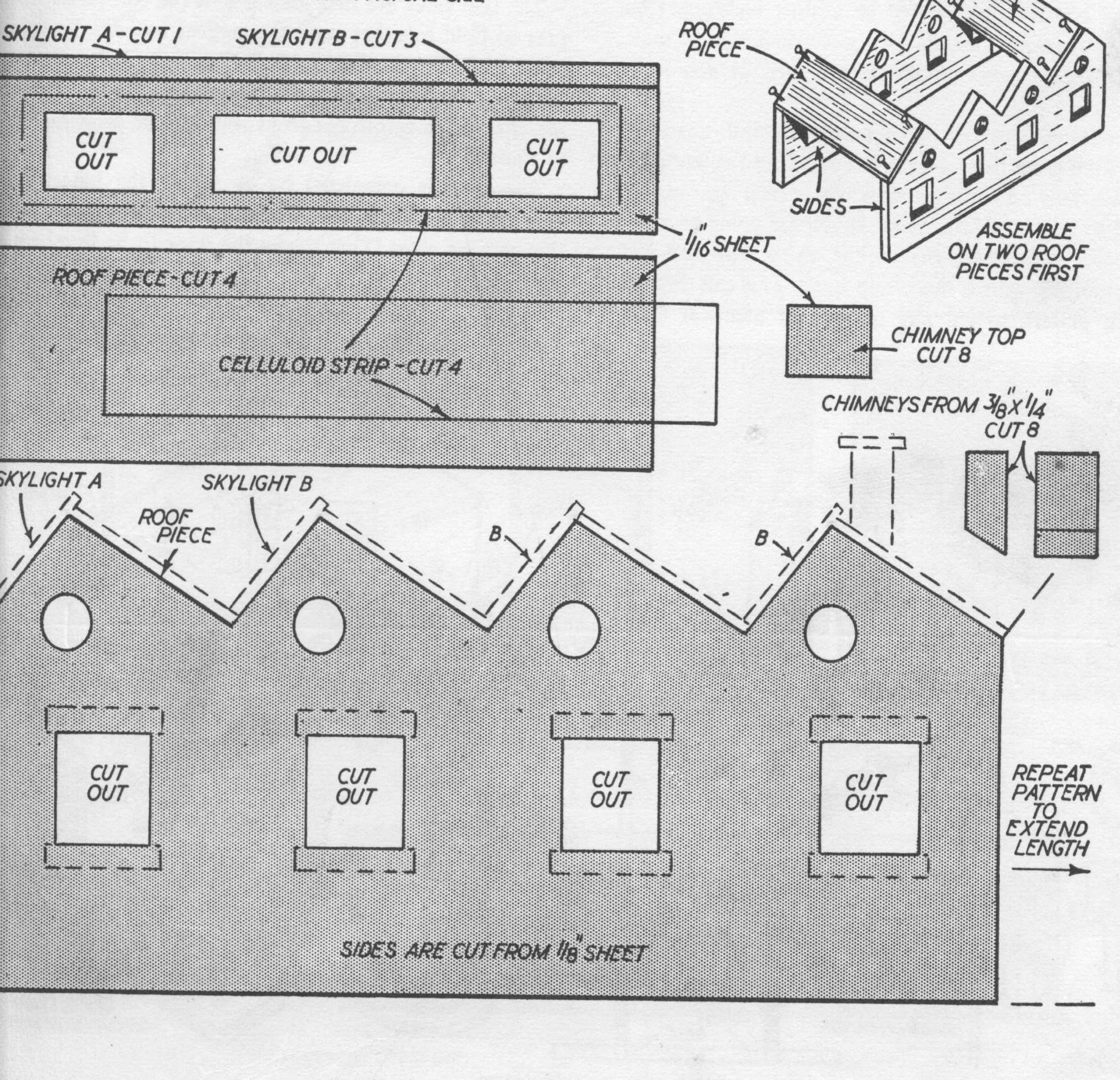
$18 \times 3 \times \frac{1}{16}$-in. sheet
One strip $\frac{1}{2} \times \frac{1}{16}$ in.
One strip $\frac{1}{4} \times \frac{1}{16}$ in.
One strip $\frac{3}{32}$-in. square





ENGINE SHED

ALL PATTERNS BELOW ARE DRAWN ACTUAL SIZE



Scale Roadside Models

Balsa offers outstanding scope for the construction of buildings and accessories to match any scale of models—inexpensive to produce and easy to construct. An authentic finished appearance can be given by painting or covering with 'brick' papers, etc.

AS TYPICAL scale roadside models we have chosen road-signs—which cost only a fraction of a penny in materials each to make—and a lock-up garage (cost approximately sixpence) in keeping with Dinky and Corgi cars and models of similar scale. A number of individual garages can be cemented together side-by-side to produce a complete row of lock-ups, if desired. More elaborate projects will probably suggest themselves after completing these simple models. A scale service station, for example, could easily be made, using similar principles of design and construction as for the airport buildings (pp. 40–41), whilst enough details for the construction of scale petrol pumps, etc., can easily be observed at any local garage.

The road sign patterns given below are full size. The sign part itself is cut from $\frac{1}{16}$-in. sheet balsa but the lettering, etc., is best done on white paper which is then cut out and cemented to the face of the balsa. If you are going to make a number of signs, trace the outline on to thin card and cut out carefully with a modelling knife. This can then be used as a pattern to cut any number of identical balsa pieces.

The pole supporting the stand is a length of $\frac{1}{16}$-in.-diameter hardwood dowel. Signs are not always mounted at a constant height and for the scale adopted any length between $2\frac{1}{4}$ and $2\frac{3}{4}$ in. is suitable. The base is a circle of about $\frac{3}{4}$-in. diameter cut from $\frac{1}{16}$-in. sheet balsa. Pierce a hole in the centre and cement in the dowel. Then paint in alternate bands of black and white *before* cementing on the balsa top.

Traffic-light signals can be constructed in a similar manner, also road junction signs and a typical island with 'Keep Left' signs—*see* illustrations. Accessories like these will add greatly to the realism of any model layout.

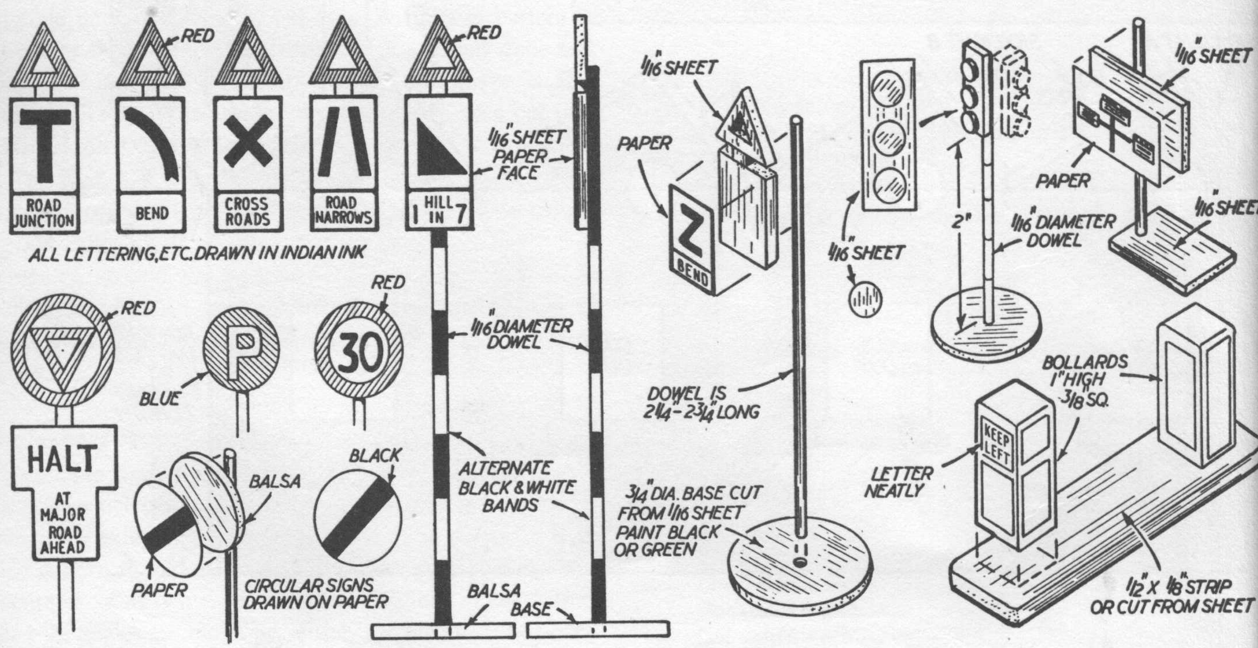
Lock-up Garage

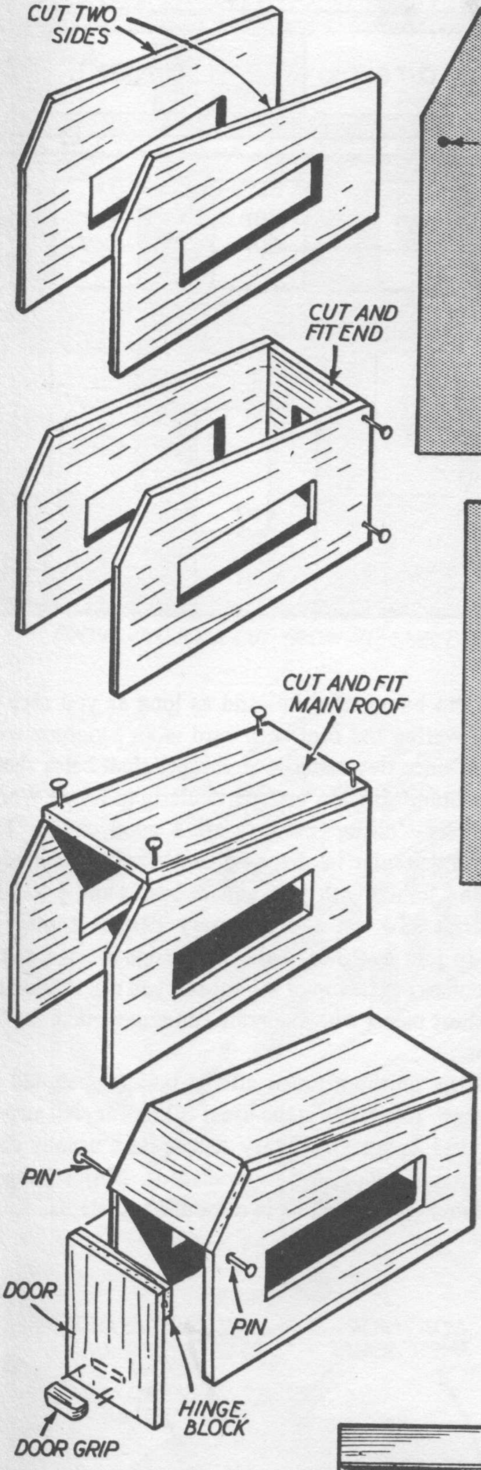
Construction of the lock-up garage is shown step-by-step on the opposite page. The patterns are actual size and so are copied direct on to $\frac{3}{32}$-in. sheet. After cutting one side it can be used as a pattern to cut the second side. All the other parts are 'one off', unless you are building more than one garage.

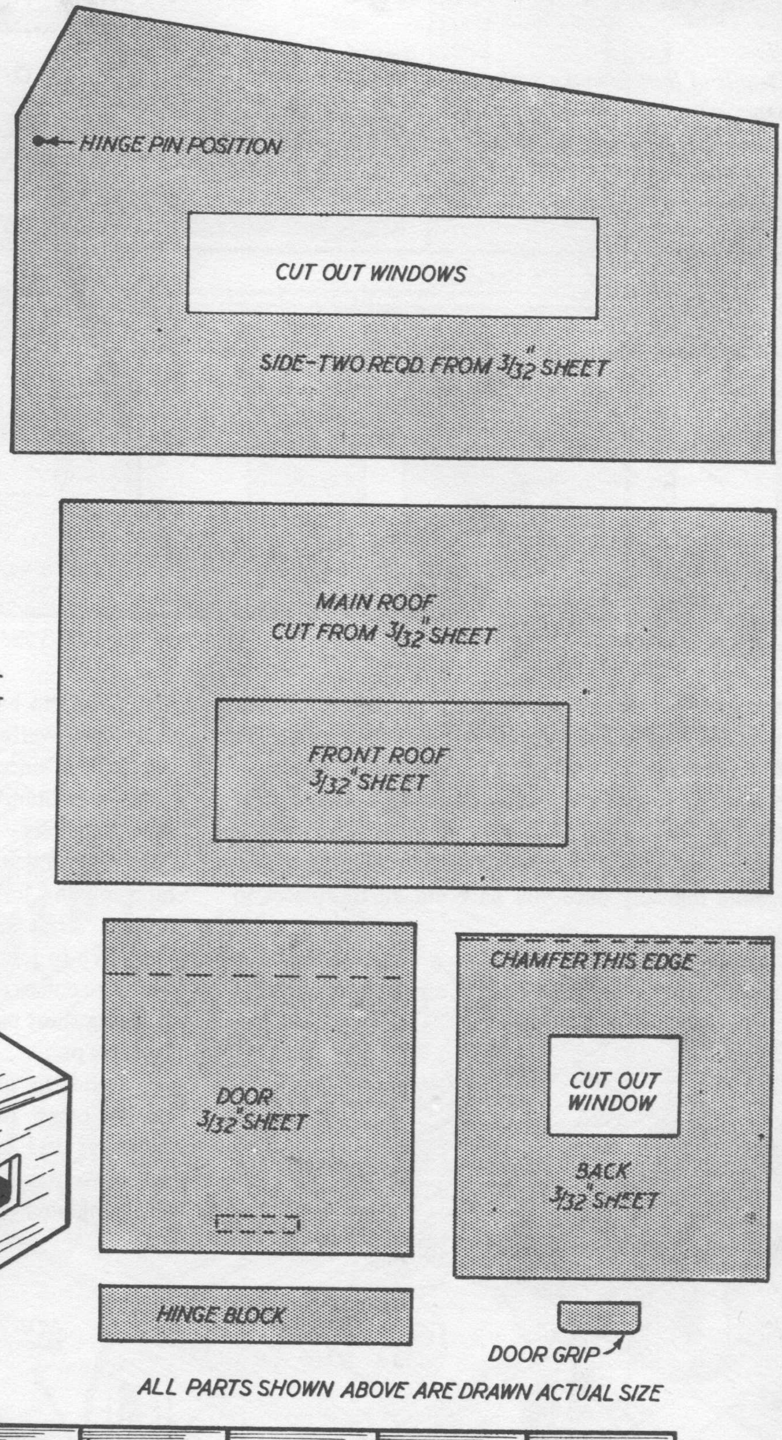
The two sides are first joined with the end piece, using pins to hold together until the cement has set. The main roof should be added straight away as this will help true up the assembly. A little bit of trimming will be required at the front edge before the front roof can be cemented also in place.

The door is completed by cementing the hinge block across the top and then fastening with two pins pushed through the sides. This allows the door to be lifted up to open.

18 × 3 × $\frac{3}{32}$-in. sheet makes one garage

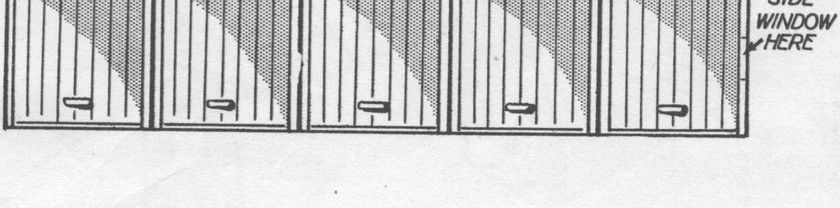






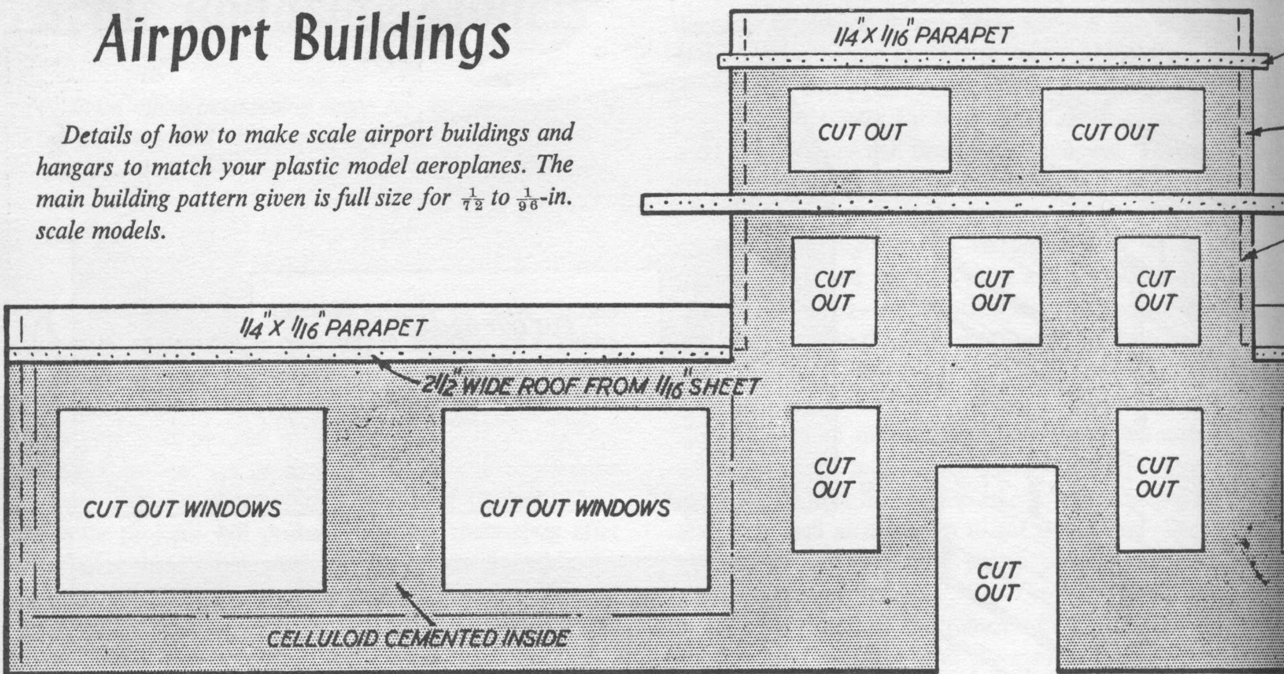
ALL PARTS SHOWN ABOVE ARE DRAWN ACTUAL SIZE

A NUMBER OF UNITS MAY BE CEMENTED TOGETHER TO MAKE A ROW OF LOCK-UP GARAGES OMIT SIDE WINDOWS EXCEPT AT TWO ENDS



Airport Buildings

Details of how to make scale airport buildings and hangars to match your plastic model aeroplanes. The main building pattern given is full size for $\frac{1}{72}$ to $\frac{1}{96}$-in. scale models.

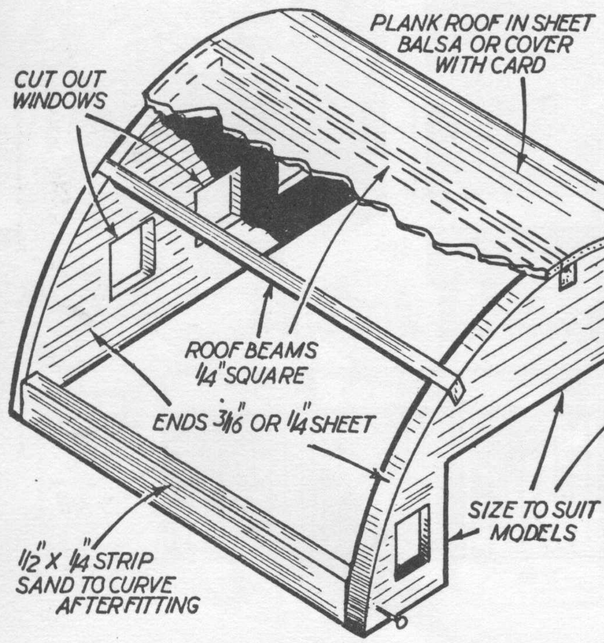


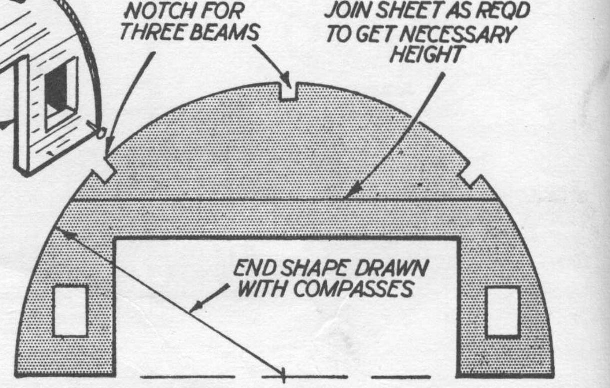
NEARLY everyone these days has amassed a collection of scale model aeroplanes, assembled from plastic model kits, so how about producing an airport to match? All the parts for the main building shown can be cut from one sheet each of $\frac{3}{32}$-in. and $\frac{1}{16}$-in. balsa, with a length of $\frac{1}{4} \times \frac{1}{16}$-in. strip for the parapets. Assembly should follow quite logically once you have cut all the pieces to size.

The size of main hangars should be proportioned to suit your largest model—i.e. wide enough and high enough for the aircraft to be wheeled in—and as long as you care to make it. Covering the roof with card is an economy with big hangars since this material is cheaper than balsa sheet.

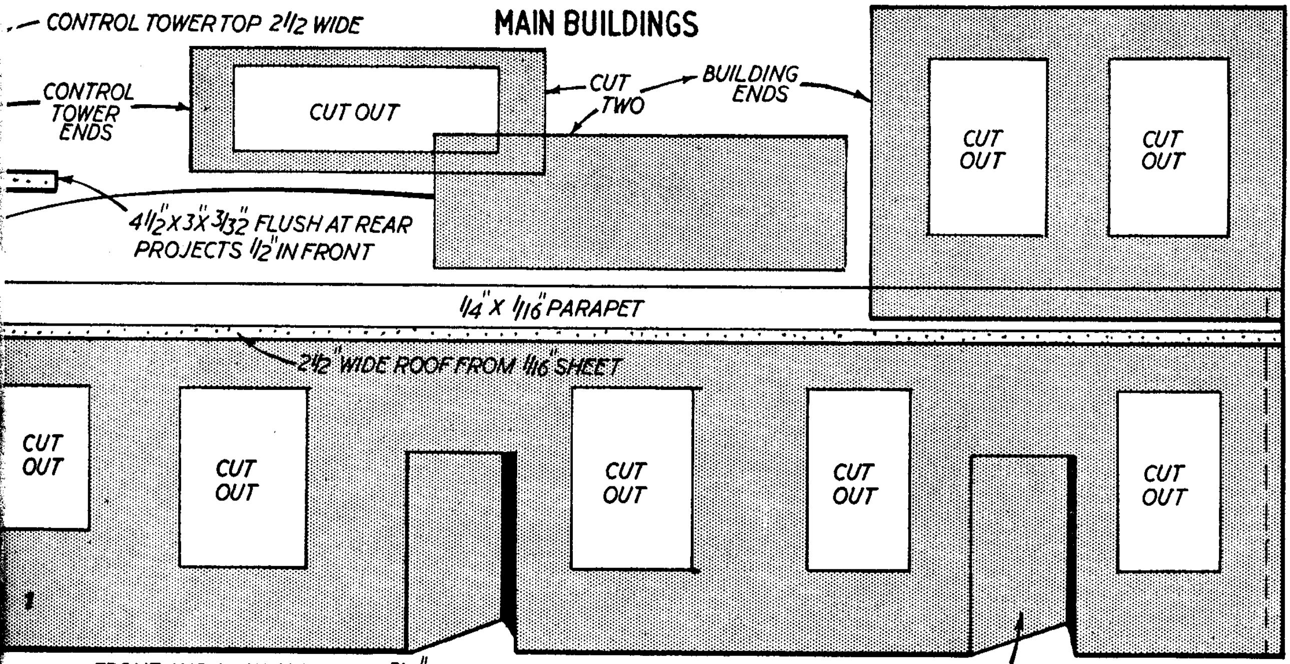
For a military airfield—and particularly to house World War I fighters—'blister' hangars are a good choice. The ends are semi-circular in shape—again 'sized' to suit your models—and joined with $\frac{1}{4}$-in. square beams and $\frac{1}{2} \times \frac{1}{4}$-in. bottom strips. To get the necessary height it may be necessary to join two 3-in.-wide sheets edge to edge. If the joint line comes on the top of the cut-out you can economize by using short pieces with the grain running vertical for the two side parts.

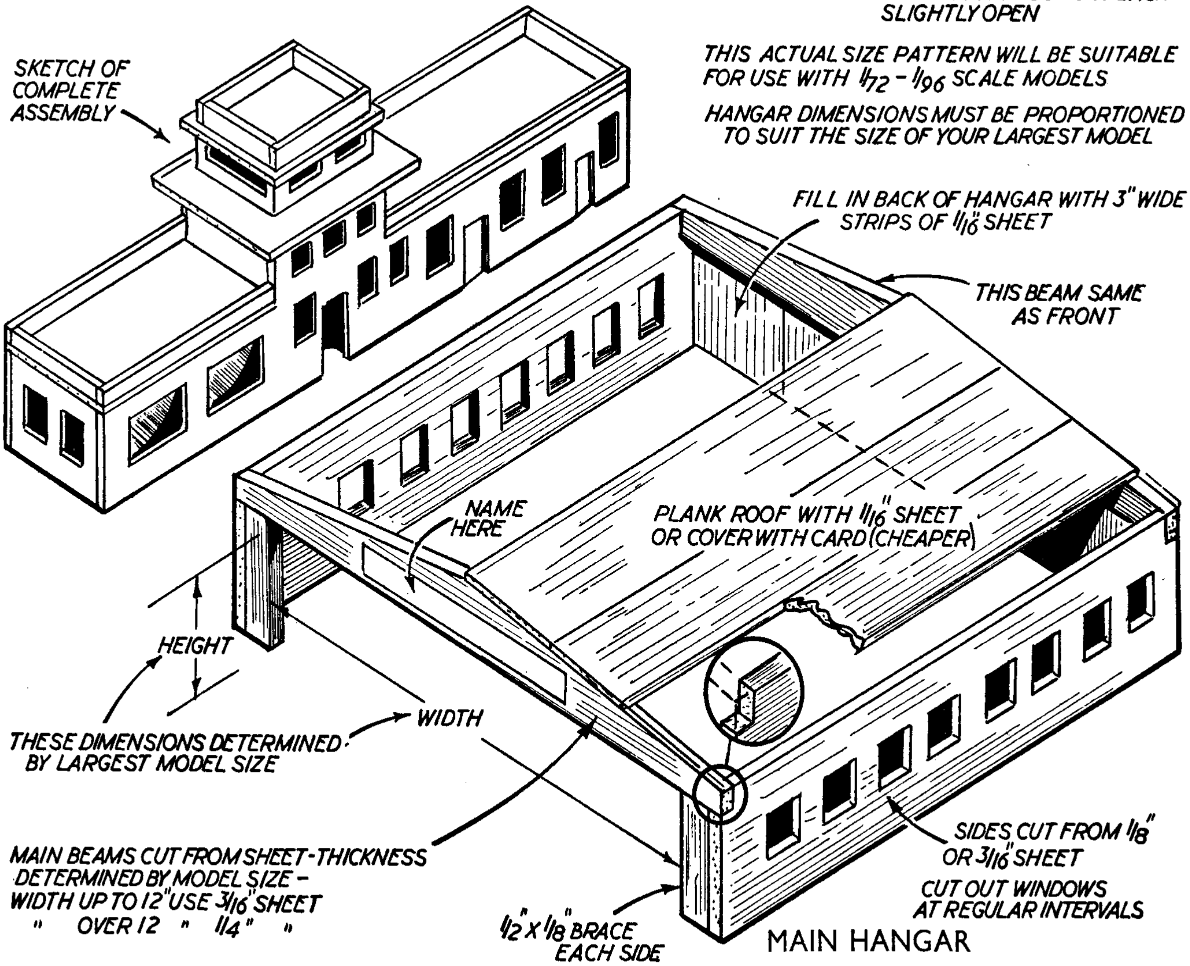
To add the finishing touch all the buildings should be painted (*see* p. 13). White is the usual colour for civil airport buildings and hangars. Military hangars are usually dark brown with grey roofs (or camouflaged). Blister hangars can be painted green, or again in camouflage patterns.



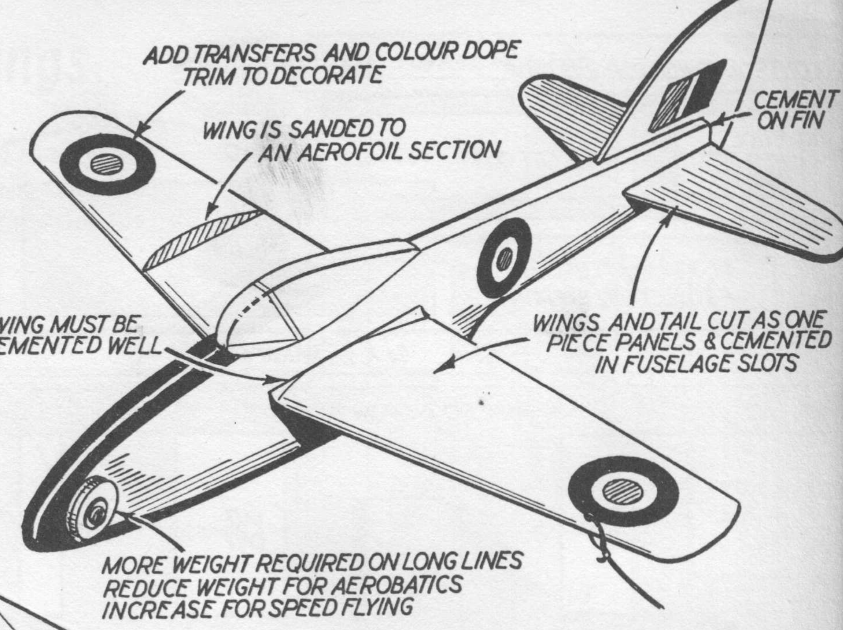


MAIN BUILDINGS





MAIN HANGAR



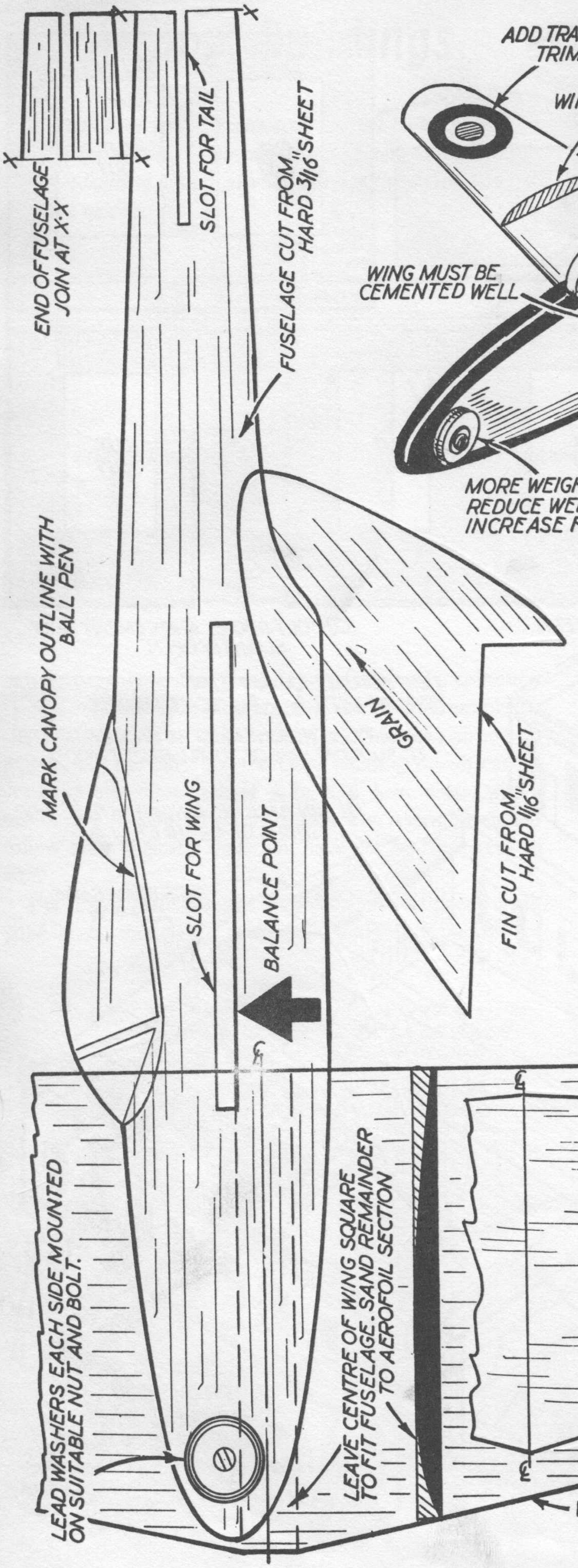
Whip-Control Models

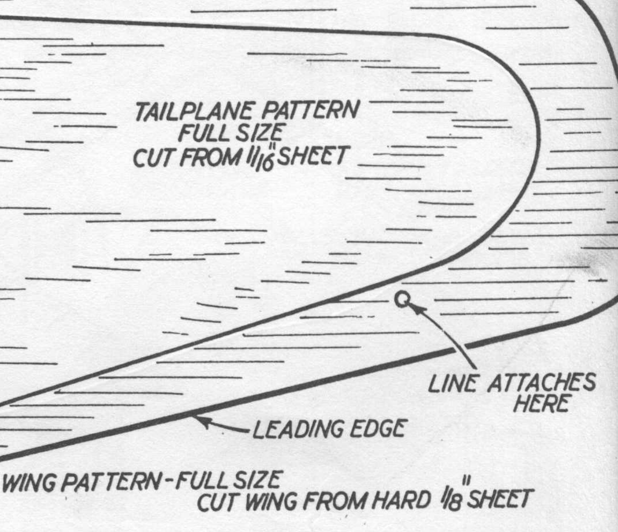
Whip-control models give you all the fun of control-line flying without the expense of an engine. *You* supply the power, a button-thread line being attached to the wing of the model and the other end to the tip of a bamboo cane about four to six feet long. Just 'whip' the model around in a circle and you will find that you can control it in dives, zooms, and even loops. Adjust the line length to suit the space in your garden—you can go up to about 25 ft. as a maximum, but the longer the line the more skill you need to keep the model flying under control.

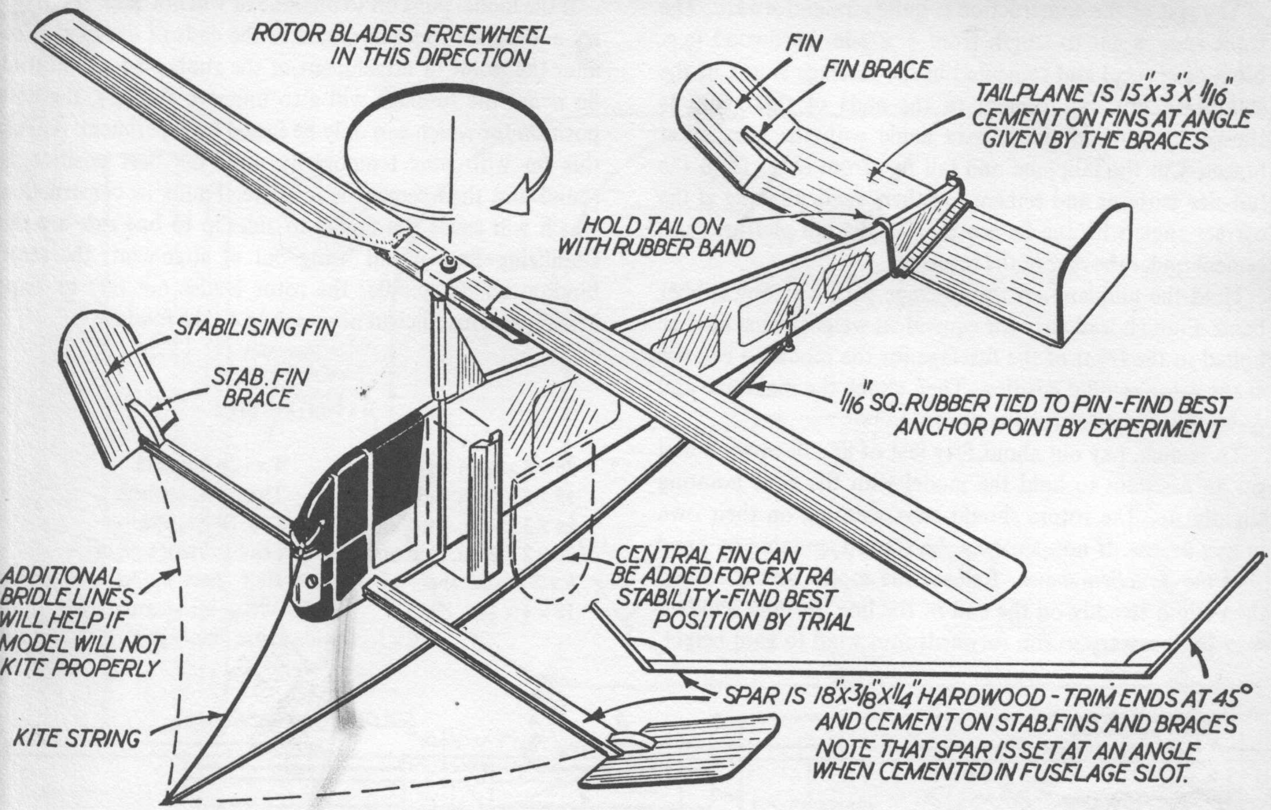
All the patterns given are full size.

MATERIAL LIST

$10 \times 2 \times \frac{3}{16}$-in. sheet	$12 \times 3 \times \frac{1}{8}$-in. sheet
$10 \times 2 \times \frac{1}{16}$-in. sheet	Lead washers. One 6BA nut and bolt







A Helicopter Kite

This is an advanced model design, yet the construction has been kept very simple and straightforward. This type of kite was actually carried by German submarines during World War II for carrying an observer aloft for 'spotting'. The model, if carefully constructed, is capable of climbing to a considerable height in moderate to strong breezes and should be as stable in flight as any conventional kite.

THIS model has to be fairly large to work properly, and is thus a more ambitious project than most of the other models described in this book. The sizes given are about the *minimum* for a successful helicopter kite, so do not attempt to scale them down. Choose medium grade balsa wood throughout and pay particular attention to making the hub and rotor assembly correctly. The rest of the model is not at all critical.

The fuselage is shown half size on the plan on the following two pages. This must be scaled up and drawn on a 24 × 3 × $\frac{3}{16}$-in. balsa sheet. Cut the spar notch carefully at the angle shown. The four cut-outs are made to lighten the rear part of the fuselage. When completely shaped and sanded smooth both sides of the fuselage should be covered with model aircraft tissue, applied with tissue paste, and then 'proofed' by giving two coats of clear model dope.

The hub patterns are given full size. The main hub part is cut from $\frac{1}{4}$-in. sheet. Two 'A' pieces are required from $\frac{3}{32}$-in. sheet and also four 'B' pieces, again from $\frac{3}{32}$-in. sheet. One 'A' piece is cemented over the middle of the hub and on this is cemented a 6-in. length of 1-in.-wide gauze bandage. The other 'A' piece then cements on top. The hub assembly is now completed by folding a 1-in.-wide strip of thin brass or tinplate closely around the hub, as shown in the detail sketches, and then either pinning or soldering in position. Drill through the centre of the hub to take the 14-gauge wire spindle as a nice free fit.

Two rotor blades are required, each 14½ in. long and shaped as shown on the plan. Cement one 'B' piece underneath the root end of each blade. The other 'B' pieces are then cemented to the underside of the bandage strip protruding from the hub and the 'B' pieces on the blades cemented on *top* of the bandage to complete the hinge assembly. Trim away the extreme end of the blade and the edge of the top 'B' piece as necessary so that each blade can 'flap' upwards easily on its hinge.

Bend the rotor spindle to the shape shown and position on the side of the fuselage, forcing the bottom turned-up piece into the fuselage. Cement the fairing strip in place to hold the wire securely. Add the pylon to the top of the fuselage and bind the wire to it with a piece of well-cemented bandage strip. Solder a washer on to the spindle just above the pylon, slip on the rotor assembly and solder another washer on top to secure.

The rest of the construction is quite straightforward. The front spar is cut to length from $\frac{3}{8} \times \frac{1}{4}$-in. hardwood (e.g. birch or spruce) and cemented in the fuselage slot. Cut the stabilizing fins and cement to the ends of this spar, as shown, aligning at the correct angle with the $\frac{1}{4}$-in. sheet braces. Cut the tailplane and tail fins from sheet from the full-size patterns and cement together, again aligning at the correct angle with the fin braces. Cut the tail platform and cement under the rear of the fuselage.

Hold the tailplane on the fuselage with a strong rubber band. Enough lead strip (or equivalent weight) must now be bolted to the front of the fuselage for the model to balance at the rotor spindle position. Then attach the main line and $\frac{1}{16}$-in. square rubber line, as shown.

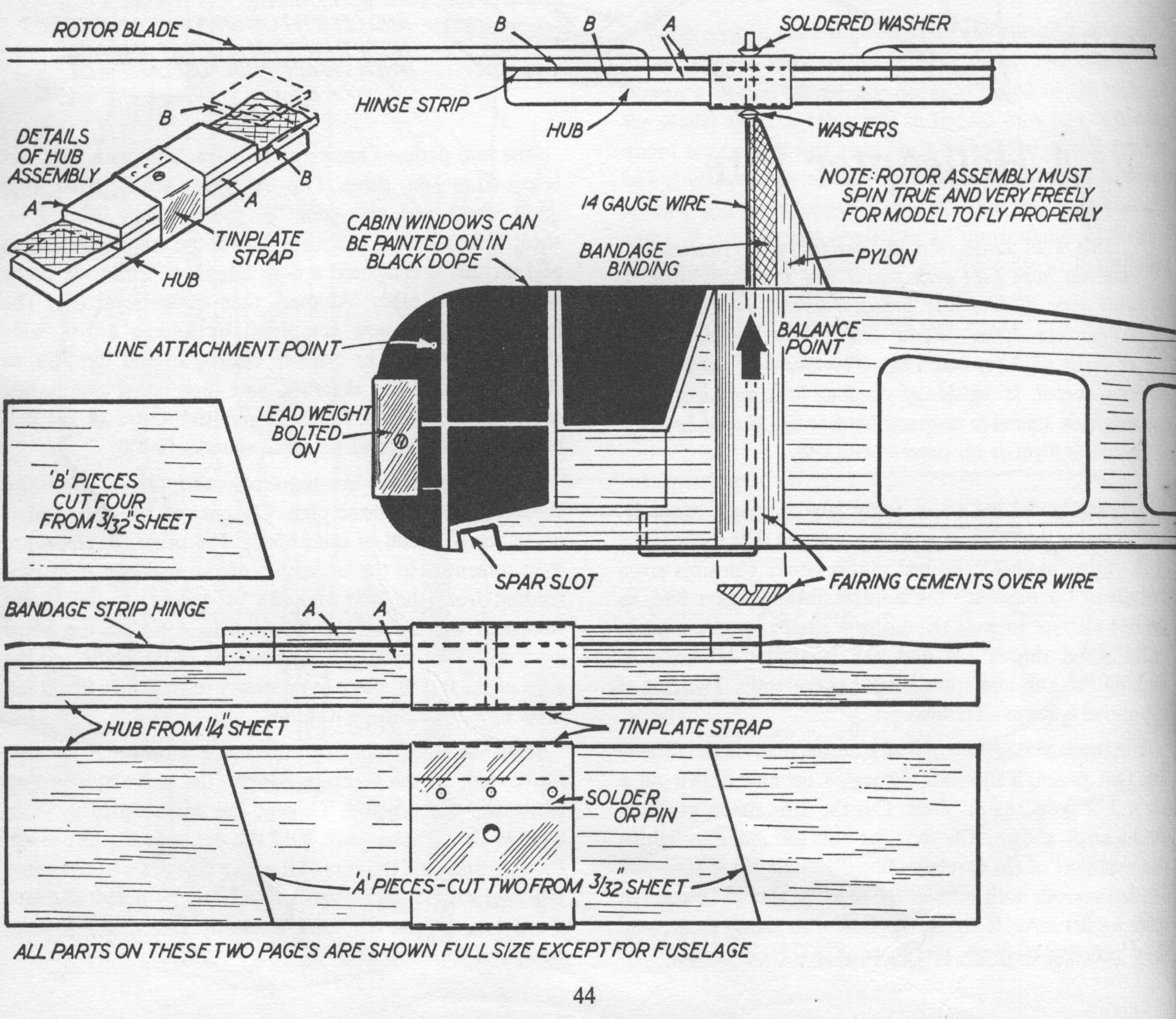
To launch, pay out about fifty feet of line downwind and get an assistant to hold the model with the nose pointing slightly up. The rotors should start rotating on their own in any breeze. If not, they can be started spinning by hand —*in the direction shown*. Release the model and it should then climb steadily on the end of the line. In light winds it may be necessary to run forwards into wind to gain height.

If the model pulls off to one side or will not 'kite' properly, try additional bridle lines tied to the ends of the spar. Also alter the point of attachment of the rubber line. A central fin *under* the fuselage will also improve stability, the best position for which can only be found by experiment. Attach this fin with pins temporarily until the best position is found and then cement it in place. Faults in construction which will cause the model to sideslip to one side are the stabilizing fins or tail being out of alignment; the rotor binding on its spindle; the rotor blades not free to 'flap' evenly; and insufficient nose weight on the fuselage

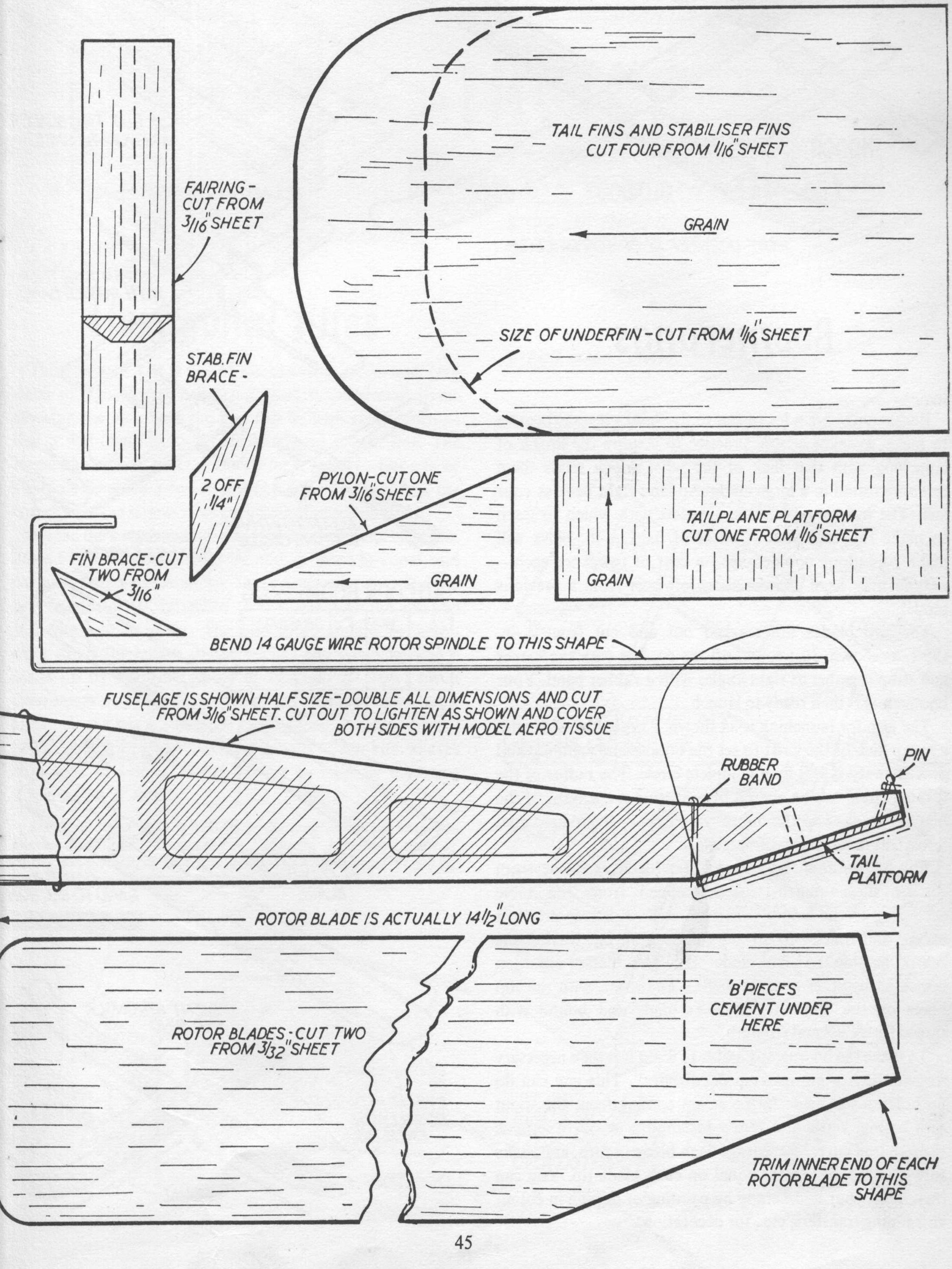
MATERIAL LIST

$36 \times 3 \times \frac{1}{16}$-in. light sheet	4×1-in. tinplate
$15 \times 3 \times \frac{1}{16}$-in. light sheet	Three cup washers
$24 \times 3 \times \frac{3}{16}$-in. medium sheet	8-in. 19-gauge wire
$36 \times 2 \times \frac{3}{32}$-in. medium sheet	Lead strip for weight
$6 \times 2 \times \frac{1}{4}$-in. sheet	Half sheet model aero tissue
$18 \times \frac{3}{8} \times \frac{1}{4}$-in. birch	2 ft. $\frac{1}{16}$-in. square rubber

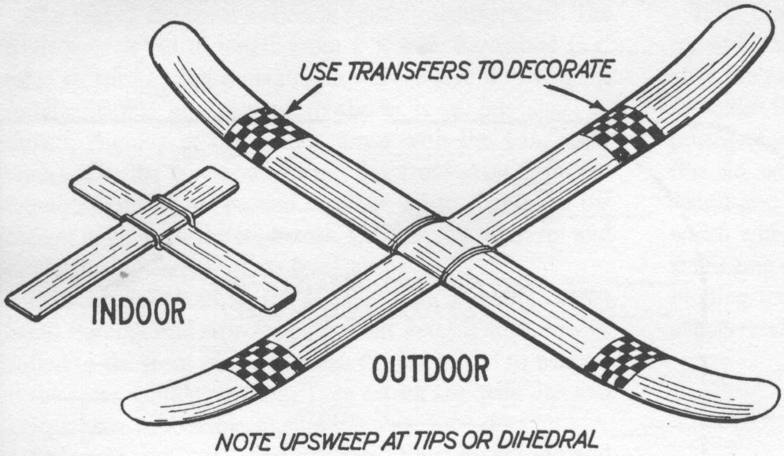
6×1-in. wide gauze bandage

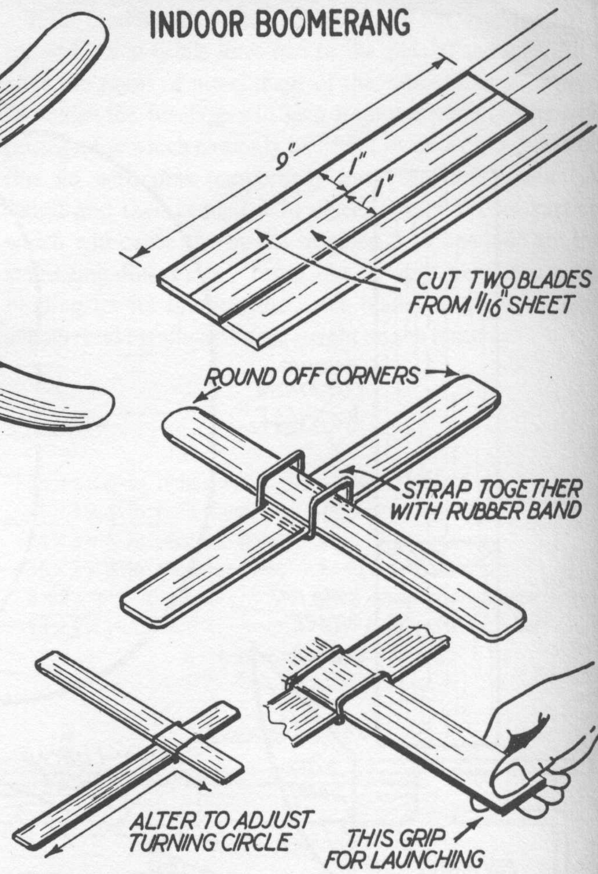


ALL PARTS ON THESE TWO PAGES ARE SHOWN FULL SIZE EXCEPT FOR FUSELAGE



TAIL FINS AND STABILISER FINS
CUT FOUR FROM 1/16" SHEET
GRAIN
SIZE OF UNDERFIN - CUT FROM 1/16" SHEET
FAIRING - CUT FROM 3/16" SHEET
STAB. FIN BRACE -
2 OFF 1/4"
PYLON - CUT ONE FROM 3/16" SHEET
GRAIN
TAILPLANE PLATFORM
CUT ONE FROM 1/16" SHEET
GRAIN
FIN BRACE - CUT TWO FROM 3/16"
BEND 14 GAUGE WIRE ROTOR SPINDLE TO THIS SHAPE
FUSELAGE IS SHOWN HALF SIZE - DOUBLE ALL DIMENSIONS AND CUT FROM 3/16" SHEET. CUT OUT TO LIGHTEN AS SHOWN AND COVER BOTH SIDES WITH MODEL AERO TISSUE
RUBBER BAND
PIN
TAIL PLATFORM
ROTOR BLADE IS ACTUALLY 14 1/2" LONG
'B' PIECES
CEMENT UNDER
HERE
ROTOR BLADES - CUT TWO
FROM 3/32" SHEET
TRIM INNER END OF EACH
ROTOR BLADE TO THIS
SHAPE





Boomerangs

Boomerangs are a lot of fun to fly—and very inexpensive to make. It takes a little practice to acquire the knack of launching with that flick of the wrist which sends them spinning round in a large circle—to land right back at your feet. The indoor type is the simplest with which to learn so make this one first. A sheet of hard $\frac{1}{16}$-in. balsa will make six indoor boomerangs—a cost of twopence each—or you may have enough sheet left over from a previous model.

The two blades are marked out and cut from $\frac{1}{16}$-in. sheet, as shown. Just round off the corners with sandpaper and strap together at right angles with a rubber band. Your boomerang is then ready to launch.

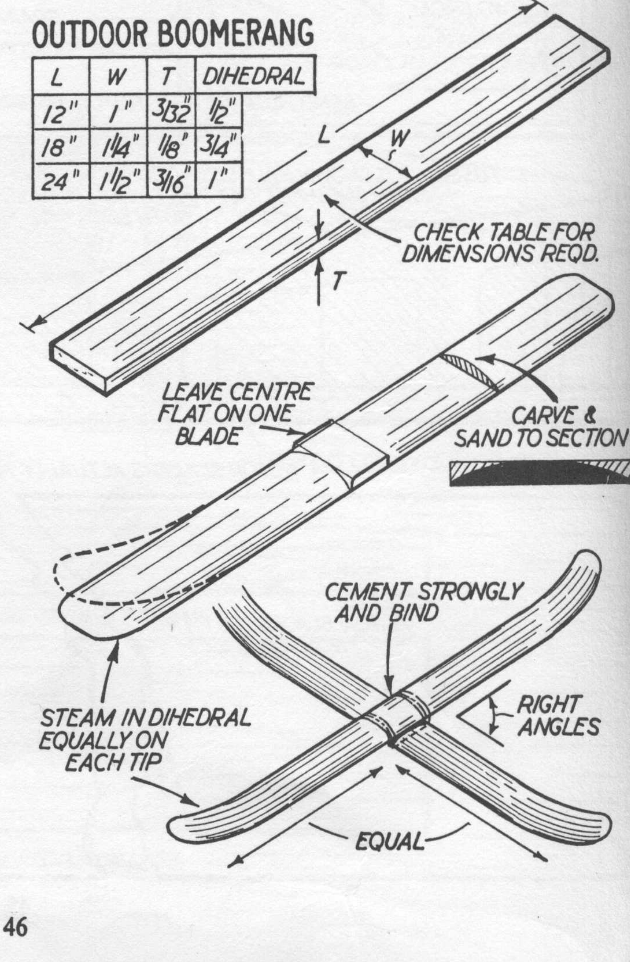
The grip for launching is as shown. Throw forwards with a sharp flick of the wrist to set the boomerang spinning and practise until it will fly a complete circle. The radius of the turning circle can be altered by adjusting the lengths of the blades, as shown, the more you depart from an equal 'cross' the larger the natural circle.

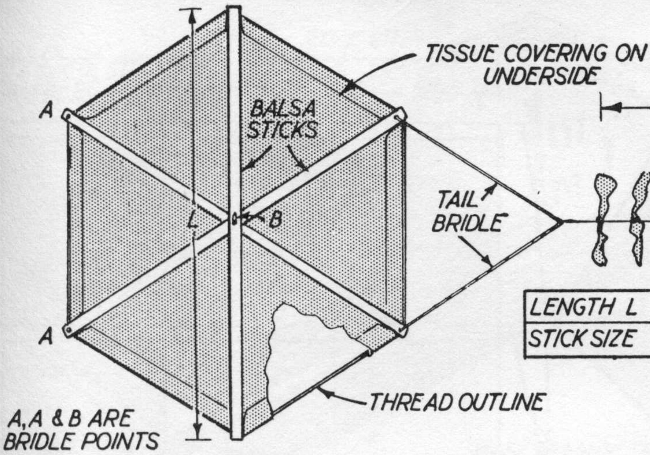
For an outdoor boomerang the blades are cut from thicker sheet—dimensions determined from the table according to the length you require. Both blades are then carved and sanded to an aerofoil section, but leaving the centre portion of one blade flat. The blades are then cemented together at right angles, as shown, with the top blade on the 'flat' of the lower blade and bound with thread for additional strength.

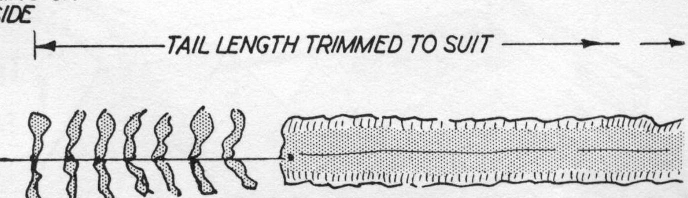
To make the boomerang stable in flight it is then necessary to give the tips an upsweep or 'dihedral'. This you can do by holding the blade in the steam coming from the spout of a boiling kettle and gently forcing the wood to assume the required curve. Repeat for each blade in turn, and make sure that the dihedral is equal on each blade tip. You can then finish your boomerang by painting or doping in colour and adding transfers, etc., for decoration.

OUTDOOR BOOMERANG

L	W	T	DIHEDRAL
12"	1"	3/32"	1/2"
18"	1 1/4"	1/8"	3/4"
24"	1 1/2"	3/16"	1"



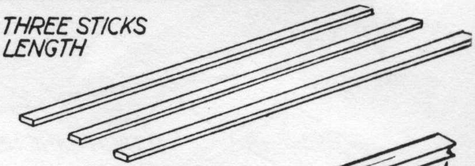


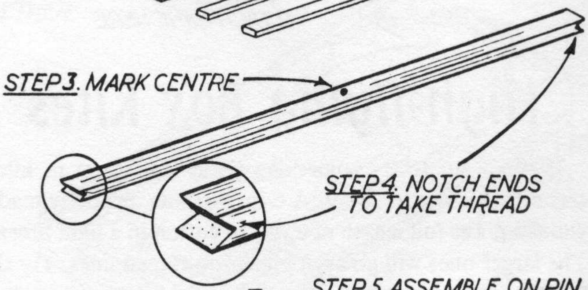


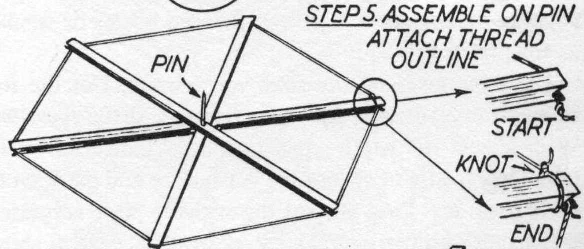
STEP 1. DECIDE YOUR KITE SIZE

LENGTH L	6"	9"	12"	15"	18"	24"
STICK SIZE	1/8"×1/16"	3/16"×3/32"	3/8"×1/8"	1/4"×1/8"	1/4"×3/16"	3/8"×3/16"

STEP 2. CUT THREE STICKS TO LENGTH







Hexagonal Kites

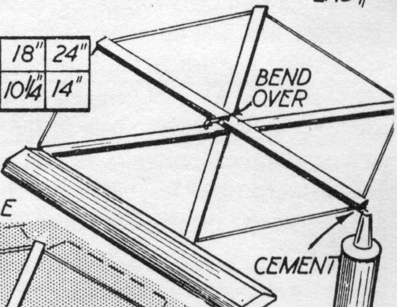
This shape of kite is one of the easiest to make and very stable in flight. Using balsa sticks and model aircraft tissue covering the weight of the kite can be kept right down so that it will climb to hundreds of feet on a light line. The bigger the kite, in general, the better it will fly—but a 6- or 9-in. kite flown on a cotton line can be lots of fun. And the cost of even the largest kite is a matter of pence only.

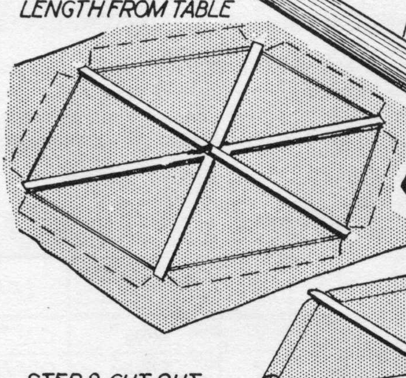
All the the constructional stages are shown quite clearly in Steps 1 to 8. The bridle lines 'A' and 'A' must be equal, and the same length as the sticks. You will then have to find the best length for 'B' (attached to the centre of the kite) to trim the kite properly. The tail string should be about eight times the length of the sticks. The complete tail is made up by knotting pieces of tissue about 4 × 1 in. at close intervals along the length of the string. On the larger kites you can use a 3-in.-wide crepe paper 'streamer' for the tail, if preferred. Add more tail length if the kite weaves from side to side in flight, but try to trim by adjusting bridle length 'B' first.

Standard balsa strip is sold in 36-in. lengths, so calculate the number of strip lengths required on this basis. A standard sheet of model aircraft tissue is 30 × 20 in. (a single sheet requiring cutting and rejoining to cover the largest kite).

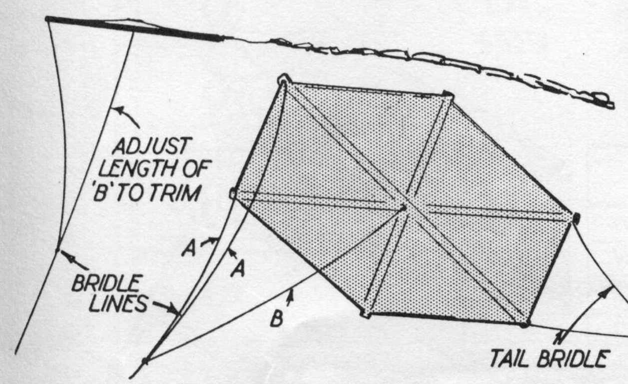
6"	9"	12"	15"	18"	24"
3½"	5¼"	6⅞"	8⅝"	10¼"	14"

STEP 6. SQUARE UP USING CHECK LENGTH FROM TABLE

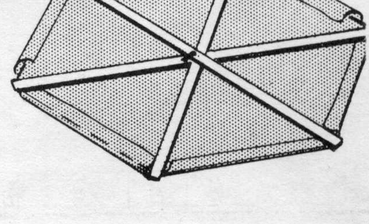


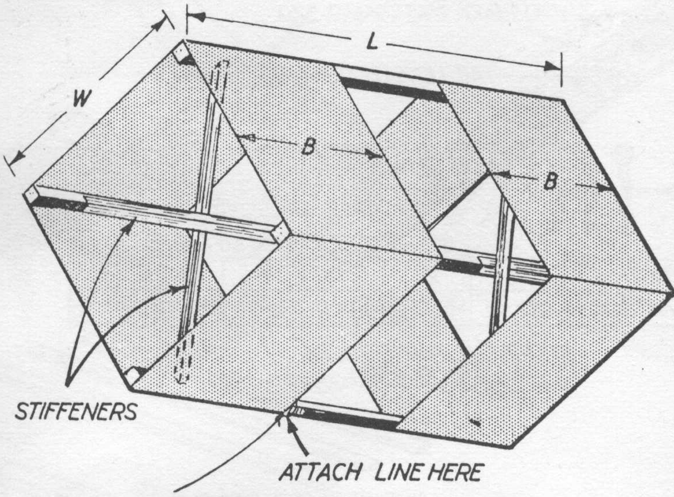


STEP 7. LAY FRAME ON TISSUE TO MARK OUT



STEP 8. CUT OUT TISSUE PANEL & CEMENT EDGES OVER OUTLINE





High-flying Box Kites

If you want to try something really miniature in kites, this is the design to adopt. A 6-in. box kite, properly made, will climb the full length of a reel of cotton in a light breeze. The larger ones will go even higher on thread lines. Try the 9- or 12-in. size for a start and then go bigger or smaller, as you prefer.

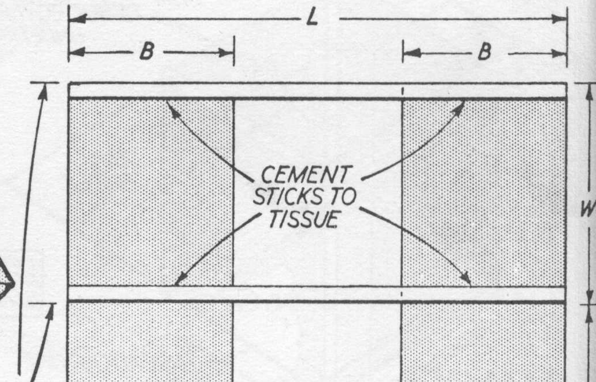
The table gives all the sizes you require. Cut the four sticks to exact length, then two strips of tissue *four times* W in length and width equal to the 'B' dimension in the table. Lay the tissue strips on a flat surface and mark on the stick positions—then cement the sticks in place accurately.

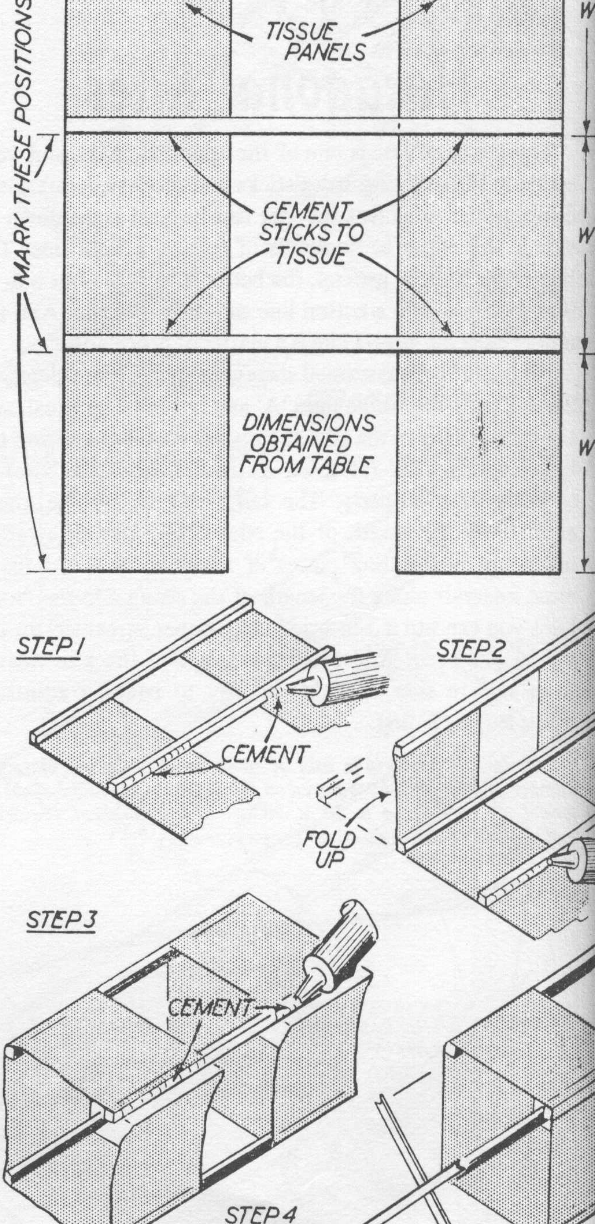
Starting with the second stick, cement the edge as shown in step 1 and fold up as in step 2. Repeat until you come to the final join where the tissue edge is stuck to the first stick—step 3. All that remains to do then is to cut the stiffeners to the length given in the table, notch the ends and cement them crosswise in each end of the kite to hold it square and rigid. Just check that the kite is square before the cement sets, otherwise it will not fly properly.

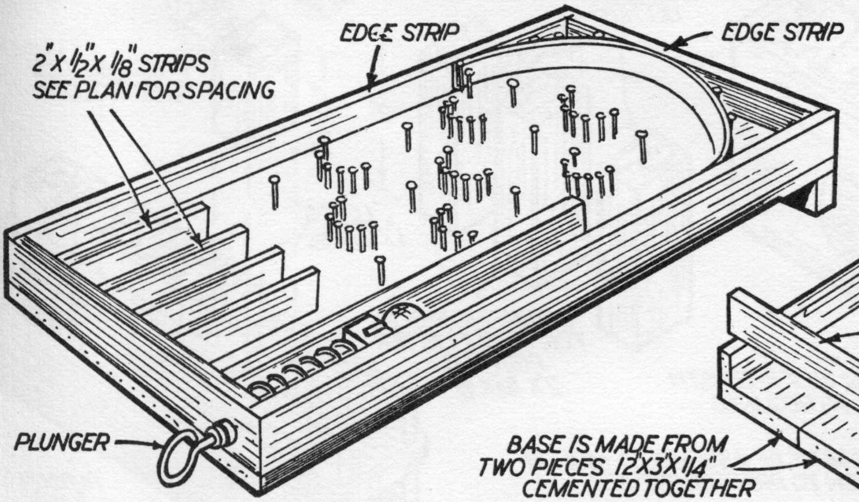
Standard balsa strip is sold in 36-in. lengths, so calculate the number of strip lengths required on this basis—e.g. an 18-in. kite will require two *lengths of 3/16-in. square strip. A sheet of model aircraft tissue is 30 × 20 in. For the 18- and 24-in. kites use 'heavyweight' tissue.*

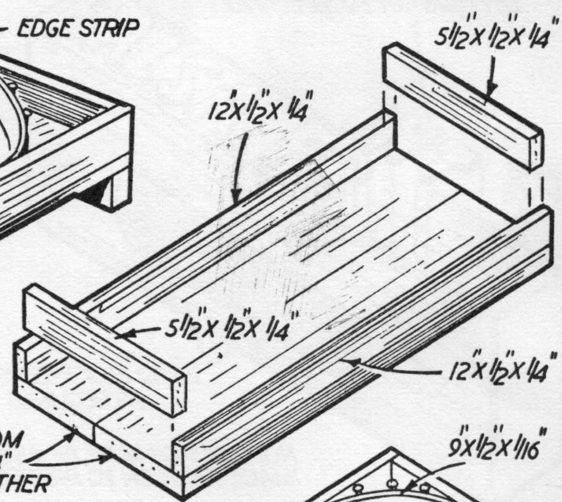
TABLE OF STICK SIZES & DIMENSIONS

LENGTH L	STICK SIZE	W	B	STIFFENER	LINE
3"	1/16" SQ.	1 1/4"	1"	1 11/16"	COTTON
6"	1/16" "	2 3/8"	2"	3 9/32"	COTTON
9"	3/32" "	3 1/2"	3"	4 13/16"	COTTON
12"	1/8" "	4 3/4"	4"	6 1/2"	THREAD
18"	3/16" "	7"	6"	9 5/8"	THREAD
24"	1/4" "	9 1/2"	8"	13 1/8"	BUTTON THREAD

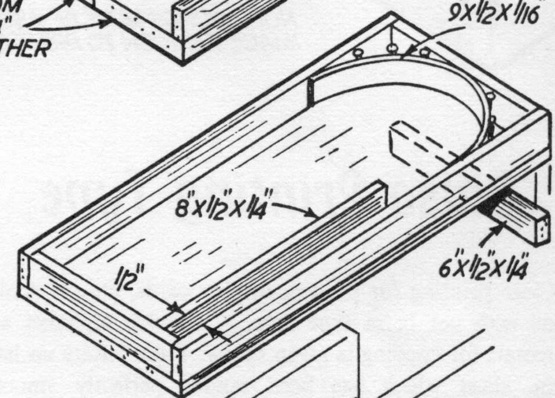








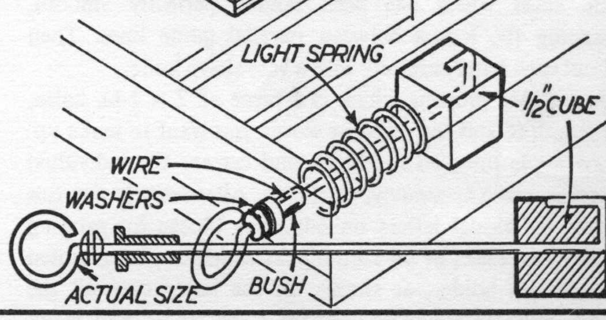
Miniature Bagatelle

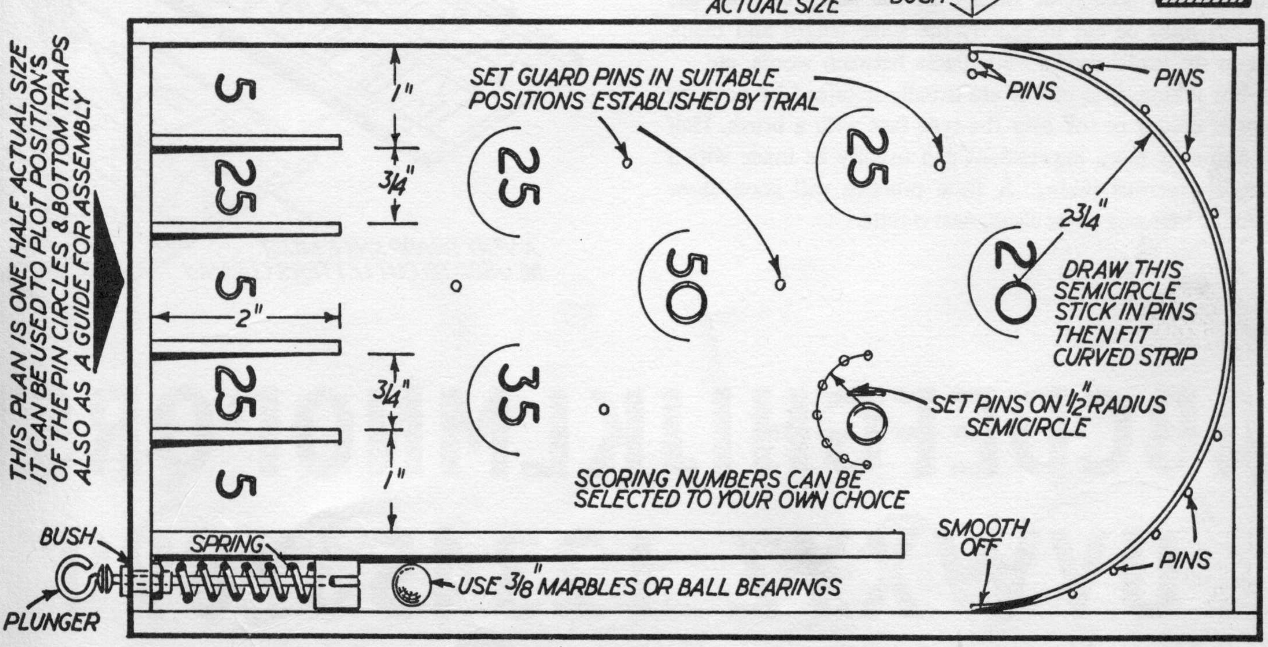


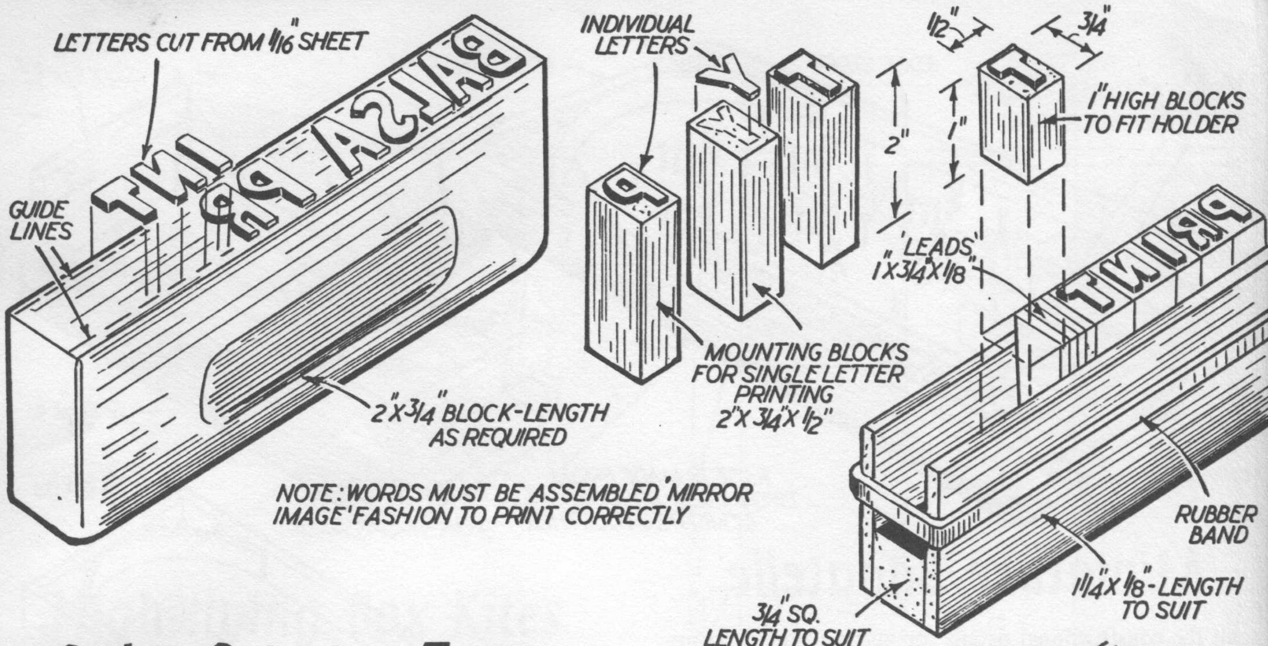
All the constructional details for making this miniature bagatelle are clearly shown in the drawings, first assembling the basic frame on the $\frac{1}{4}$-in. sheet base and then adding the other strips. The $\frac{1}{2}$-in. cube can be made from two $\frac{1}{2}$-in. lengths of $\frac{1}{2} \times \frac{1}{4}$-in. strip cemented together. Sand down so that the plunger operates freely without binding. The scoring numbers you can paint on, or mark with transfers, altering the values suggested if you prefer.

MATERIAL LIST

$24 \times 3 \times \frac{1}{4}$-in. sheet (for base)
Two lengths $\frac{1}{2} \times \frac{1}{4}$-in. strip (50 in. required)
One length $\frac{1}{2} \times \frac{1}{16}$-in. strip (9 in. required, but you may break one or two)
One length $\frac{1}{2} \times \frac{1}{8}$-in. strip (8 in. required)
4 in. of 18-gauge wire. 18-gauge brass bush and nut
Light spring. $\frac{5}{8}$-in. pins. $\frac{3}{8}$-in. ball bearings





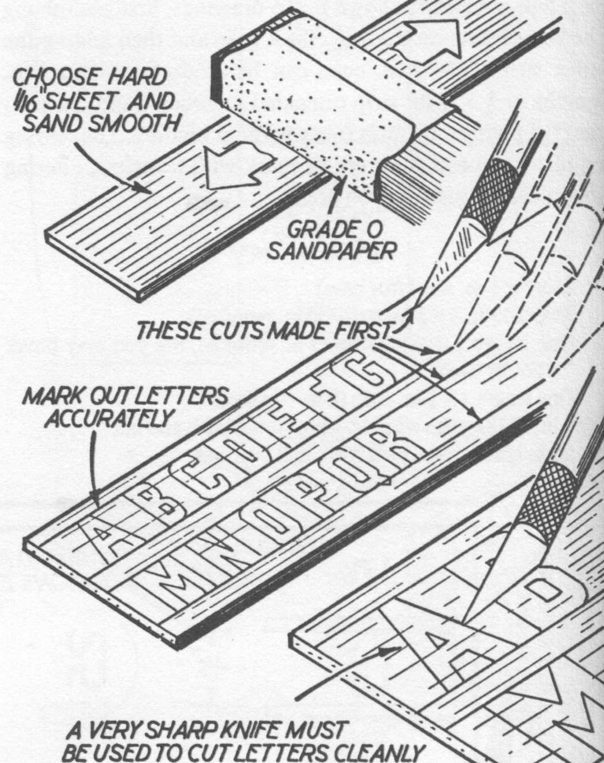


Balsa Printing Type

Clear printing for posters, display cards, etc., is readily done with cut balsa type face. A suitable alphabet and numerals for copying is given below. Trace letters on hard $\frac{1}{16}$-in. sheet which has been sanded perfectly smooth, arranging the letters between parallel guide lines. Then cut out each letter carefully with a very sharp knife.

A suitable printing block is a piece of 2 × $\frac{3}{4}$-in. balsa, the length to suit the word or words you want to make up. Draw guide lines on the block and cement the individual letters in place accurately, as shown. Alternatively you can mount individual letters on 2-in.-long blocks for printing a letter at a time; or on 1-in. blocks which can be mounted in a simple holder, as shown. In the latter case all the blocks *must* be cut to exactly the same length and blank strips or 'leads' used to fill spaces between words, etc.

For inking, best results are usually obtained by painting poster colour or ink over the type face with a brush. Half a dozen or more impressions can usually be made with a single generous inking. A little practice will soon show you the best way to get clean, neat results.



ABCDEFGHIJKLMNOPQRST

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Every boy is a modeller at heart, and this book is aimed at the schoolboy with limited pocket money. It tells him how to make working models in that inexpensive and easily worked material—balsa wood.

The opening chapters describe marking-out, cutting, shaping and assembling techniques, with a full description of the range of simple tools needed for the modeller's workshop. The remainder of the book is devoted to plans of some different models, each complete with full-size patterns and profusely illustrated with step-by-step diagrams covering all assembly stages. Models described include rubber-powered cars—flying aircraft—kites—a model fort—model railway accessories—cabin cruisers etc. General techniques are also described for making scale models of all types, so the book will remain a permanent reference manual.

This book, now in its seventh impression, is written by one of the world's leading authorities on models and modelling and should continue to attract fathers as much as their schoolboy sons.

SEVENTH IMPRESSION